ABSTRACTS OF NORTH AMERICAN GEOLOGY

October 1966

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1966

UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402.

Price 45 cents (single copy). Subscription price: $5.00 a year (12 monthly issues); $1.25 additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (December 8, 1965).

(exp. 12-68)

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings.

The Abstracts will be an additional reference tool but will not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology will be published each year. The Bibliography will include citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are being prepared by use of computer techniques. Each abstract along with its indexing is placed on magnetic tape and entered into a permanent data bank. The material prepared each month will be published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

The abstracts in this issue were prepared by Arthur P. Butler, Jr., R. A. Cadigan, F. W. Cater, Georgianna D. Conant, Margaret Cooper, W. C. Culbertson, R. C. Douglas, Andrew Griscom, C. C. Hawley, J. J. Hemley, Virginia M. Jussen, B. H. Kent, E. R. Landis, E. H. Lathram, B. F. Leonard, Elisabeth S. Loud, E. K. Maughan, Mildred C. Mead, A. T. Miesch, D. R. Mullineaux, Virginia S. Neuschel, D. W. Rankin, A. E. Roberts, G. I. Smith, V. E. Swanson, J. G. Vedder, Dorothy B. Vitaliano, W. S. White, D. H. Whitebread, and R. E. Wilcox.

ABSTRACTS

5273 **Adams, William Mansfield.** A thermal tool for direct investigation of the interior of the Earth: Pure and Appl. Geophysics, v. 61, p. 113–122, illus., table, 1965.

Direct access to the crust and upper mantle may be achieved by letting a high-temperature (>1,100°C) reactor core melt the rock and fall through the resulting magma. Data gathering and retrieval seem feasible. A schematic design of the proposed instrument is given. Many problems concerning the composition and conditions of the interior of the Earth require access to greater depths than any drilling project will attain. It is recommended that such a heat-generating object be placed on top of a salt dome to melt its way through the salt and underlying rock. If the tool can generate heat long enough to melt its way up as well as down it may be possible to obtain magma samples. Instrumentation for control and telemetry purposes appears extremely difficult; initial emphasis is on attaining the depth of interest.—D.B.V.

5299 **Addicott, W. O.** New Tertiary marine mollusks from Oregon and Washington: Jour. Paleontology, v. 40, no. 3, p. 635–646, illus., 1966.

Biostratigraphic studies of the larger invertebrate faunas of marine upper Oligocene to Pliocene formations of coastal Oregon and southwestern Washington have disclosed nine new gastropods and four pelecypods, described and figured herein, from the Middle Miocene Astoria Formation and from the late Miocene to early Pliocene Montesano Formation of Weaver (1912). *Buccinum hannibali* (Hertlein), also from the Montesano Formation, is figured and reviewed. Two new species are reported from the uppermost part of the Lincoln Formation of Weaver (1912) of southwestern Washington, and three new taxa are described from the Newport embayment, Oregon, from the Yaquina Formation and Nye Mudstone.—V.S.N.

Adler, H. H. *See* Nininger, R. D. 5404

5066 **Adler, Hans H.** Infrared spectroscopy and hydrogen bonding–frequency shifts and band splitting in mineral spectra [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 258, 1966.

Allan, J. F. *See* Grayston, L. D. 5016

5307 **Allen, Jack C., Jr.** Structure and petrology of the Royal stock, Flint Creek Range, central-western Montana: Geol. Soc. America Bull., v. 77, no. 3, p. 291–301, illus., tables, geol. map, 1966.

This homogeneous granodiorite epizonal stock is of late Cretaceous–early Tertiary age and has an area of approximately 30 sq mi. Structural and petrologic features are consistent with forceful intrusion of a magma. The primary joint pattern may reflect an intrusion of prismatic-cylindrical shape which plunges parallel to the plane of the joints.—A.G.

5311 **Allison, Ira S.** Pumice at Summer Lake, Oregon—A correction [to 1945 paper]: Geol. Soc. America Bull., v. 77, no. 3, p. 329, 1966.

A lake-land layer of sandy pumice incorrectly correlated with Mt. Mazama pumice (ibid., v. 56, no. 8, p. 789-807, 1945) is more than 30,700 C-14 years old. True Mazama air-land pumice 6,600 years old lies on the lake flat.—Author's abstract

Alonso, R. M. *See* Gelabert, P. A. 5285

5192 **Anderson, Roger Y.** Varve calibration of stratification, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 1-20, illus., table, 1964 [1966].

Where varves are found associated with features not usually related to them, they can be used to calibrate the bedding process. The Florissant lake beds in Colorado are given as an example of second-order stratification (2-30 yrs), and the Beaverhill Lake Formation in Alberta and the Monterey in California, for third-order (100-300 yrs). Fourth- and fifth-order stratification (1,000-3,000 yrs) and (10,000-30,000 yrs), are discussed briefly.—E.S.L.

5305 **Anderson, Roger Y.; Kirkland, Douglas W.** Intrabasin varve correlation: Geol. Soc. America Bull., v. 77, no. 3, p. 241-255, illus., tables, 1966.

Statistical methods are applied to correlated laminations within four sedimentary basins to show the degree of lateral variations in thickness. Stratigraphic units studied include the Pleistocene Rita Blanca Lake beds of Texas, the Jurassic Todilto Formation in New Mexico, the Permian Castile Formation of southeastern New Mexico and West Texas, and the Permian Zechstein Formation in Germany. Varved sequences of organically or chemically precipitated laminae can be correlated regionally, but correlation coefficients for equivalent sections decrease with increasing distance. There seems to be no relation between thickness in alternating calcite and anhydrite laminae.—J.G.V.

5037 **Andrews, J. T.; Smithson, B. B.** Till fabrics of the cross-valley moraines of north-central Baffin Island, Northwest Territories, Canada: Geol. Soc. America Bull., v. 77, no. 3, p. 271-290, illus., tables, 1966.

Analyses of 103 till fabrics taken from proximal and distal slopes of cross-valley moraines in the Isortoq Valley show variations in fabric pattern with respect to slope and location within the valley. Four distinct morphological moraine types delineated are: simple-linear, s-shaped, hooked, and asymmetric. Analyses indicate hooked, asymmetric, and simple-linear moraines are formed by dissimilar processes or changes in intensity of the same process. S-shaped moraines differ morphologically from simple-linear but have the same fabric characteristics. Cross-valley moraines probably form at the base of an ice cliff grounded in a glacial lake. Influx of summer meltwater provides a trigger mechanism and explains association between moraines and water-deposited kame features. Asymmetric moraines were deposited by overriding and pushing; moraines at right angles to the ice cliff were formed by squeezing of till into basal crevasses or meltwater channels.—*from* Authors' abstract

5193 **Angino, Ernest E.** Trace elements and cyclic deposition, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 21-30, illus., tables, 1964 [1966].

Most trace-element studies made to date have been on noncyclic deposits. This discussion attempts to focus attention on the possible presence of trace-element cycles, correlative with sedimentary cycles. Although the presence of a given trace element will probably not be of value, groupings can furnish valuable information concerning probable physiochemical conditions prevailing in a given environment. The approach used here also emphasizes the dearth of information available on the distribution of trace elements within the separate fractions making up any rock unit. More data on this distribution is necessary before it is possible to completely understand any specific paleoecologic study.—E.S.L.

5359 **Antal, Paul S.** Diagenesis of thorium isotopes in deep-sea sediments: Limnology and Oceanography, v. 11, no. 2, p. 278-292, illus., tables, 1966.

Yields of Th-227, -230, and -232 extracted from Caribbean Sea sediment samples of known age are compared with radionuclide content obtained by complete sample dissolution and with data on red clays in Pacific Ocean cores; comparisons indicate internal consistency of dates and sedimentation rates is insufficient to prove validity of leaching procedures. Yields of authigenic Th-230 decrease with depth in the core, whereas leaching of Th-232 is independent of depth. Transformation of initially soluble precipitate of Th-230 in the sediment to a more acid-resistant state has an apparent half-life of 24,000 years at 3C. In solution obtained by partial extraction, decrease of the Th-230/Th-232 ratio with depth in the core is due to radioactive decay and decreased solubility of authigenic Th-230; thus, sedimentation rates calculated from (Th-230/Th-232) solution may be too low by a factor of three.—*from* Author's abstract

5238 **Anthony, Harold E.** Childs Frick (1883–1965): Soc. Vertebrate Paleontology News Bull. 77, p. 46–55, portrait, 1966.

5067 **Appleman, Daniel E.** The crystal structure of melanophlogite, a cubic polymorph of SiO_2 [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 258, 1966.

Austin, Carl F. *See* Goldsmith, Werner. 5312

5270 **Axelrod, Daniel I.** Origin of deciduous and evergreen habits in temperate forests: Evolution, v. 20, no. 1, p. 1–15, illus., table, 1966.

Deciduous hardwoods first appeared at lower middle latitudes in the Northern Hemisphere during the early Cretaceous, associated with broadleafed evergreens in areas of warm climate; later the deciduous hardwoods migrated to higher latitudes. The deciduous habit may have been initially an adaptation to moderate drought in the cooler part of the year, a relation that still exists in climates such as in Taiwan, southern Mexico, and Yunnan, where today there are forests most like those of the late Cretaceous and early Tertiary. Broadleafed evergreens have dominated middle high southern latitudes of moist, cloudy rainforest climate to which the Cretaceous and Tertiary deciduous trees were not so adaptive. Basic patterns of distribution of angiosperm families are shown in the table.—G.D.C.

5284 **Axelrod, Daniel I.** The Pleistocene Soboba flora of southern California: California Univ. Pubs. Geol. Sci., v. 60, 79 p., illus., tables, 1966.

Plant remains in early Pleistocene lake beds of the Bautista Formation represent 41 species assigned to five plant communities ranging from pine forest to chaparral. This flora, from the southwest side of the San Jacinto Mountains, Riverside County, suggests effective forest migration from the Sierra Nevada during early Pleistocene. The Soboba flora indicates a relatively cool, humid climate correlated with the Kansan (or Nebraskan?) Stage; the Bautista flora, from deposits about 500 feet higher in the same formation, indicates a milder, dryer climate correlated with the late Kansan or early Yarmouth Stages. The inferred climate of Soboba time was characterized by 15 to 20 inches more precipitation than now and 8°F lower mean annual temperatures. Quaternary plant geography of the region is reconstructed.—G.I.S.

Baadsgaard, H. *See* Burwash, R. A. 5010

5245 **Baadsgaard, H.** Geochronology: Dansk Geol. Foren. Medd., v. 16, no. 1, p. 1–48, illus., tables, 1965.

This paper is a partial condensation of a series of lectures given at the Mineralogisk-Geologisk Institute of the University of Copenhagen in 1964. Following a brief review of the basic principles of radioactive decay, general descriptions, analytical measurements, and evaluations are given for various isotopic ratios used as "nuclear clocks"; then a discussion of the application to dating of lead minerals, with a theory and models for Pb-mineralization, and determination of violation of basic criteria. Examples of updating are given for gneisses of Maryland and Precambrian rocks of Texas; and of the effects of metamorphism in Colorado and Alberta. Finally in the complex interpretation for sedimentary rocks, the various materials used are evaluated.—G.D.C.

5263 **Backus, M. M.** Teleseismic signal extraction: Royal Soc. [London] Proc., ser. A, v. 290, no. 1422, p. 343–367, illus., tables, 1966.

The reduction of additive ambient noise in the 0.5–2.0 cps range and of signal-generated noise resulting from scattering is discussed. A 0.5–2.0 cps (or broader) representation of the teleseismic signal as it appears in the upper mantle at the recording location, with additive noise reduced to a hypothetically predictable level, should be achievable at a number of locations by an appropriate combination of isotropic trapped and leaking noise reduction subsystems, built into large aperture directional scanning arrays, with filtering to reduce reverberation where important.—D.B.V.

5268 **Bailey, D. K.; Schairer, J. F.** The system Na_2O–Al_2O_3–Fe_2O_3–SiO_2 at 1 atmosphere, and the petrogenesis of alkaline rocks: Jour. Petrology, v. 7, no. 1, p. 114–170, illus., tables, 1966.

Equilibria involving acmite, albite, nepheline, quartz, and a liquid phase constitute the petrologically important part of the system. The limiting ternary systems are diagrammed and discussed, and six triangular joins of greatest geologic interest are explored. Results are listed in an appendix and presented in liquidus diagrams. All the relevant data on the ternary invariant points of bounding faces of the tetrahedron are assembled in tables from which a diagram is constructed showing how the univariant lines are linked within the tetrahedral model. With this diagram the course of crystallization of any liquid may be deduced. All the liquid trends are dictated by the incongruent melting relation of acmite. Solid phases in the system are discussed, and petrologic applications of the experimental results described for specific rocks.—E.S.L.

5416 **Bamber, E. W.** Type lithostrotionid corals from the Mississippian of western Canada [with French abs.]: Canada Geol. Survey Bull. 135, 28 p., illus., tables, 1966.

Type specimens of species of *Lithostrotion, Lithostrotionella, and Thysanophyllum* are described, most of them from the Banff Formation and Rundle Group of the Rocky Mountains of Alberta and British Columbia. *Lithostrotionella jasperensis* Kelly and *L. confluens* Easton are junior synonyms of *L. microstylum* (White). New information is presented from additional thin sections. Other occurrences are included in the text.—G.D.C.

5202 **Barnes, Charles Winfred.** Reconnaissance geology of the Priest River area, Idaho [abs.]: Dissert. Abs., v. 26, no. 9, p. 5365, 1966.

5019 **Barss, D. L.; Best, E. W.; Meyers, N.** Triassic, Chap. 9 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 113–136, illus., geol. maps, 1966.

Triassic deposition, subdivided into Intervals A, B, and C, began in the Eastern Cordillera and Plains with a rapid marine transgression eastward, continuing through Interval B; in the western Cordillera, a general absence of Lower Triassic and frequent unconformity with the Permian indicate uplift and erosion in Interval A. There, in more widespread Middle Triassic seas, eugeosynclinal volcanic rocks and marine sediments were deposited in two parallel northwest trending troughs (possibly a third in the Queen Charlotte–Vancouver islands area). The eugeosynclinal pattern of Interval C was similar to that of B, but a barrier of sandy and carbonate banks along the site of the present Foothills, resulted in evaporitic sediments to the east. The Rhaelian uplift ended Triassic deposition; subsequent erosion reduced the eastern limits of Triassic units in the Eastern Cordillera and Plains.—G.D.C.

5021 **Barton, Robert H.; Christiansen, E. A.; Kupsch, W. O.; Mathews, W. H.; Gravenor, C. P.; Bayrock, L. A.** Quaternary, Chap. 14 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 195–200, illus., geol. map, 1966.

Although this brief review is largely concerned with stratified and unstratified glacial deposits of western Canada, Quaternary volcanic rocks are recorded in British Columbia and deposits of suspected Quaternary age have been mapped. Variations in drift thickness are attributed to preglacial topography which was little modified by the ice. Deposits shown on the distribution map are probably all of Wisconsinan age. A postulated preglacial drainage pattern shows increased derangement westward with maximum diversion occurring near the Laurentide ice front. The Quaternary stratigraphy is incomplete.—G.D.C.

5151 **Bates, Robert G.** Aeroradioactivity survey and areal geology of parts of Ohio and Indiana (ARMS–I): U.S. Atomic Energy Comm. Civil Effects Study CEX–59.4.23, 19 p., illus., 1966.

An airborne radioactivity survey was made of an area of 11,250 sq mi in central and western Ohio and eastern Indiana. Approximately 90 percent of the area is covered by glacial deposits ranging from a few to several hundred feet in thickness. In the nonglaciated southeast corner, exposures of bedrock are common. Outwash deposits cover the bottoms of the larger valleys and patches of loess mantle the valley sides and ridges. Little geologic information was obtained from the radioactivity data. The interlobate area formed between the Miami and Scioto glacial lobes during late Wisconsin time is outlined by a radioactivity low. Two exposures of Ohio Shale north of Columbus, Ohio, are outlined by radioactivity highs.—*from* Author's abstract

Batum, Ozen. *See* Eichholz, G. G. 5099

5318 **Baumli, George R.; Kennedy, David N.** North Coastal area investigation (preliminary edition): California Dept. Water Resources Bull. 136, 160 p., illus., tables, 1964.

Previous reports show that most of the usable supplies of ground water in the mountainous North Coastal area of California are found in widely scattered alluviated valleys and coastal plains. The objective of this investigation is to formulate plans for optimum development of water resources, considering all potential purposes, including storage for local needs and transbasin diversion of surplus supplies to deficient areas. As all the streams naturally flow to the Pacific Ocean, this would involve tunneling through the Coast Range to the Sacramento Valley. The extent and intensity of available geologic studies are discussed. The Upper Eel River Basin was selected for the initial facility of the State Water Project.—G.D.C.

Baur, Werner H. *See* Zahrobsky, R. 5004

Bayrock, L. A. *See* Barton, Robert H. 5021

5340 **Beerbower, James R.** Cyclothems and cyclic depositional mechanisms in alluvial plain sedimentation, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 31–42, tables, 1964 [1966].

A simple model of an alluvial plain environment includes six distinct elements channel, crevasse channel, levee, crevasse distributary, abandoned channel, and floodplain. Study of the model suggests that natural alluvial plains will tend to

develop an internal cyclicity, so that the absence of cyclothems, or certain types of cyclothems, may require explanation. It may result from slow subsidence and aggradation, or from random interaction of several cyclic mechanisms. From the model, it must be concluded that cyclothemic patterns in alluvial plain sediments should be very widespread, and stratigraphers should devote more attention to search for cyclothems beyond the Carboniferous.—E.S.L.

5343 **Belyea, Helen R.; Moyer, G. L.; Grey, F. F.; Grayston, L. D.** Upper Devonian, Chap. 6 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 60–88, illus., tables, 1966.

The Upper Devonian marine transgression began with deposition of the Beaverhill Lake Formation, a cyclical repetition of carbonates and shales in central Alberta, which pass laterally northward into shales and southeastward into carbonates and evaporites; a belt of reefs occurs near the edge of the platform west of Edmonton. Continued subsidence is believed to have caused southward migration of the carbonate front and reef build-ups; increase in evaporites to the southeast suggests uplift in that direction. The overlying carbonate-siltstone sequence grades upward to carbonates of the Wabamun Group, which tongues out to shale in northeastern British Columbia. The latest known Devonian in western Canada is a sequence of green shales and limestones, succeeded by the black shales of the Devonian–Mississippian boundary.—G.D.C.

5196 **Benson, R. H.** Designation of ostracode lectotypes: Jour. Paleontology, v. 40, no. 3, p. 745–747, 1966.

Lectotypes are selected from syntypic series for new species described by Benson and collaborators between 1959 and 1964. The new lectotypes and the holotypes are transferred to the U.S.National Museum.—R.C.D.

Berkman, S. C. *See* Spaeth, M. G. 5138

5277 **Berthelsen, Asger; Noe-Nygaard, Arne.** The Precambrian of Greenland, *in* The geologic systems—The Precambrian, V. 2: New York, Interscience Publishers, p. 113–262, illus., tables, 1965.

The study discusses the Precambrian according to seven geographic divisions: South Greenland and southern East Greenland—the pre-Ketilidian, Ketilidian, and Gardar; southern West Greenland—the pre-Nagssugtoqidian complexes; central West Greenland—the border relations, tectonic structure, and regional division of the Nagssugtoqides; northern West Greenland—the main geologic divisions and post-basement rocks; the northwestern part—the metamorphic basement complexes and suprastrata; the northeastern part—the suprastrata of the Danmarks Fjord region and southern Peary Land, and the Caledonides of Kronprins Christians Land; and northern and central Greenland—the Caledonian fold belt and Dronning Louise Land. A short chapter on geochronology concludes the report.—E.S.L.

Best, E. W. *See* Barss, D. L. 5019

5372 **Bhattacharyya, B. K.; Clay, D. N.** Machine methods as aids in the preparation of geophysical maps: Canada Geol. Survey Paper 66-9, 18 p., illus., 1966.

This paper describes two methods that would aid a map compiler in finishing a map based on the computer-processed results of geophysical data. One method that uses the printer is suitable for the preparation of a map for small rectangular areas. The other method, using an x-y plotter, is suitable for large areas in which the convergence of longitude lines and the curvature of latitude lines cannot be ignored. This latter method uses Lambert Conformal Conic Projection for the

preparation of maps. These methods considerably shorten the time required in representing processed values in the form of maps.—Authors' abstract

5345 **Bhattacharyya, D. S.** "Experimental deformation and recrystallization of quartz" and "Experimental evidence of basal slip in quartz"—A discussion [of papers by J. M. Christie and others and N. L. Carter and others, 1964]: Jour. Geology, v. 74, no. 3, p. 366–367, 1966.

The postulated preference (Christie, Griggs, and Carter, ibid., v. 72, p. 734, 1964; and Carter, Christie, and Griggs, ibid., p. 687) of quartz to deform by slippage on the basal plane is questioned.—R.E.W.

5068 **Bideaux, R. A.; Nichols, M. C.; Williams, S. A.** The arsenate analogue of tsumebite, a new mineral [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 258–259, 1966.

5042 **Bielenstein, H. U.; Charlesworth, H. A. K.** Precambrian sandstone sills near Jasper, Alberta: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 405–408, illus., 1965.

Two sandstone sills in Precambrian rocks near Jasper are up to 22 feet long and one foot thick. Each extends laterally from the base of a bank of a scour channel eroded in slate and filled in by sandstone. Intrusion took place while the sediments were unconsolidated as the result of variation in confining pressure caused by differential compaction.—Authors' abstract

5336 **Billings, Marland P.; Wilson, J. Robert** Chemical analyses of rocks and rock-minerals from New Hampshire: New Hampshire Div. Econ. Devel. Mineral Resources Survey, pt. 19, 104 p., illus., tables, 1964 [1965].

In these tables, 218 analyses, of which 35 are new, give major constituents for 155 rocks and 63 rock-minerals from New Hampshire. In addition, 83 analyses of trace elements in rocks are included; 18 are of rocks for which major constituents were determined. Uranium and thorium contents of 44 rocks are listed separately. The major arrangement of tables is based on the geological units shown on the bedrock map of New Hampshire (Billings, 1956), in six groups subdivided into formations, metamorphic grade, and original lithology. Optical and X-ray data for most of the rock-minerals are assembled in one table.—G.D.C.

Bird, Allan G. *See* Downs, George R. 5422

5341 **Bissell, H. J.** Patterns of sedimentation in Pennsylvanian and Permian strata of part of the eastern Great Basin, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 43–56, illus., table, 1964 [1966].

In eastern Nevada and western Utah, sediments of the Pennsylvanian Ely Group exhibit rhythmic and cyclic arrangement of skeletal to bioclastic, calcarenitic, micritic, and detrital limestones, aggregating 1,500 to 2,000 feet in thickness. The Permian Arcturus Group, approximately 6,000 feet thick, consists of limestones plus shale and siltstone, sandstone, dolomite, and gypsum. Units are cyclically arranged in some areas, and elsewhere recurrent, rhythmic, or in triad or tetrad patterns. The entire succession of the Guadalupian Park City Group is cyclically arranged or rhythmically controlled triads and tetrads of limestones, arenaceous criquinites, dolomite, and dolomitic sandstone. The interpretation is advanced that patterns of sedimentation were mainly controlled by diastrophism within and adjacent to the depocenters.—E.S.L.

5282 **Black, Robert F.** Some contributions of Wisconsin's geologists and soil scientists, *in* Sciences, arts and letters in Wisconsin history: Wisconsin Acad. Sci., Arts and Letters Trans., v. 54, pt. A, p. 107–117, 1965.

Recording of basic knowledge of geology and soils of Wisconsin began in 1634 when Nicolet explored the Door Peninsula for fur trade and mineral wealth; later missionary explorers alluded to minerals in writings, but it was Le Sueur's collections (1702) that led to opening of the famed lead–zinc deposits. The 1852 final report of the first geologic study directed by Owen in 1839 summarized extensive findings. Lapham's 1846 report on geography, topography, history, geology, mineralogy, antiquities, natural history, soil, productions, population, and government provided information for newcomers and is invaluable as a historical tool. The 1854 report of the first State Geological Survey by Daniels also included information on loess. A permanent Geological and Natural History Survey was created in 1897; Black suggests expansion of its present activities.—M.C.M.

5424 **Blum, P. A.; Gaulow, R.; Jobert, Georges; Jobert, Nelly.** On ultra-long period seismometers operating under vacuum: Royal Soc. [London] Proc., ser. A, v. 290, no. 1422, p. 318–322, illus., table, 1966.

A new ultralong period seismometer, operating in a vacuum, has been devised and put in operation in various stations for the study of the free and forced oscillations of the Earth. Photoelectric detection allows telerecording, amplification, and filtering. Results concerning the free periods from the Alaska earthquake (28 March, 1964) are given.—Authors' abstract

5011 **Bold, W. A. van den.** Ostracode zones in Caribbean Miocene: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 1029–1031, table, 1966.

Two range-zones of ostracodes can be recognized in the Caribbean region, a *Procythereis* cf. *deformis* Zone (middle lower–upper middle Miocene) and a *Mutilus confragosus* Zone (upper Miocene–Recent). These zones are separated by an interval (upper–middle Miocene) in which neither species occurs.—A.E.R.

5361 **Bold, W. A. van den.** Miocene and Pliocene Ostracoda from northeastern Venezuela: Koninkl. Nederlandse Akad. Wetensch. Verh., Afd. Natuurk., ser. 1, v. 23, no. 3, 43 p., illus., tables, 1966.

Ostracode faunas of Miocene and Pliocene surface and subsurface formations of Cubaigua island, Araya Peninsula, and Cumana, Venezuela, and those of surface formations in Trinidad are compared, and correlation of the Miocene Cubaigua Formation of Venezuela with the Miocene Springvale and Manzanilla Formations of Trinidad is suggested. Ninety-two species of ostracodes, including 16 new, are described from Venezuela; in a few cases, holotypes have been selected from Recent deposits off the coast of Trinidad.—V.M.J.

5152 **Books, Kenneth G.** Aeroradioactivity survey and related surface geology of parts of the San Francisco region, California (ARMS-I): U.S. Atomic Energy Comm. Civil Effects Study CEX-58.4.5, 23 p., illus., table, 1966.

A recent aeroradioactivity survey of 14,000 sq mi in the San Francisco region, Calif., shows a moderate range of 0 to 1,000 counts per second in the levels of natural radioactivity. Lower levels can be related to unconsolidated sediments with high water content and higher levels can be related to igneous rocks or alluvium and soils derived from igneous rocks. Continuous radioactivity profiles were obtained with scintillation counting equipment at approximately 500 feet above the ground on parallel northeast–southwest flight lines spaced one mile apart. A map of aeroradioactivity levels was prepared from the profiles.—*from* Author's abstract

5300 **Borgman, Leon E.** Reply [to comments by C. Lomnitz, 1966, on "Upper bounds for damage due to geophysical hazards", 1965]: Jour. Geophys. Research, v. 71, no. 8, p. 2183, 1966.

In his criticism (ibid., p. 2182) Lomnitz missed the point of Borgman's example A, which was purposely chosen so that values obtained from the model could be

compared with estimates computed from better data–based values, and thus check the validity of the model. Models are desirable for cases where it is not possible to rely solely on the data. Any model represents its author's intuition as to the underlying mathematical structure of the phenomenon; if his assumptions are satisfactory the model, as calibrated by data, can be used to extrapolate further than is possible with the data alone.—D.B.V.

5139 **Bowen, Oliver E., Jr.** William E. Ver Planck, 1916–1963: California Div. Mines and Geology Spec. Rept. 84, p. 6, portrait, 1965.

5398 **Bowen, Oliver E., Jr.; VerPlanck, William E.** Stratigraphy, structure, and mineral deposits in the Oro Grande Series near Victorville, California: California Div. Mines and Geology Spec. Rept. 84, 41 p., illus., table, geol. map, 1965.

Detailed information from re–mapping of the Carboniferous(?) Oro Grande Series, described here, allows revision of the sequence at the type locality, adding two units in adjoining fault blocks. The Oro Grande Series was complexly deformed and eroded prior to emplacement of the Triassic(?) Sidewinder Volcanic Series and granitic intrusion; a large displacement is indicated on the Central Ridge fault. Remnants of subsequent thrusting of units of the Oro Grande Series indicate still later deformation and faulting. Reserves of limestone, dolomite and quartzite in this Series amount to hundreds of millions of tons each, from which there has been large production. Small but important deposits of gold, silver, copper and lead also have been found.—G.D.C.

5306 **Bowin, C. O.; Nalwalk, A. J.; Hersey, J. B.** Serpentinized peridotite from the north wall of the Puerto Rico Trench: Geol. Soc. America Bull., v. 77, no. 3, p. 257–269, illus., tables, 1966.

Study of contents of three dredge hauls from north wall of Puerto Rico Trench near long 66°30′ W., and seismic profiles suggest that stratigraphy of north wall may be serpentinized peridotite with altered basalt overlain by Upper Cretaceous sedimentary rocks in turn overlain by Lower Tertiary sedimentary rocks and minor vitric basalt. The ultramafic rocks occur as two distinct types: One contains antigorite and talc and has a rare texture consisting of very fine–grained olivine(?) replaced by talc or serpentine, and the other contains neither antigorite nor talc and has a texture similar to serpentinites from many localities in the world. The 5.1 kmps seismic layer here may be composed primarily of serpentinized peridotite with some altered basalt; about 65 km east, the 5.1 kmps layer was sampled and basalts, chert and Cenomanian siliceous sedimentary rock were obtained.—E.H.L.

Bowman, Merton C. *See* Fox, Richard C. 5320

5069 **Bown, M. G.** A new amphibole polymorph in intergrowth with tremolite—Clino–anthophyllite? [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 259, 1966.

5234 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Natural gamma aeroradioactivity map of the Pittstown and part of the High Bridge quadrangles, Hunterdon County, New Jersey: U.S. Geol. Survey Geophys. Inv. Map GP–573, scale 1:24,000, 1966.

5235 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Natural gamma aeroradioactivity map of the Frenchtown and part of the Riegelsville quadrangles, New Jersey and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP–571, scale 1:24,000, 1966.

5378 **Boynton, Robert S.** Chemistry and technology of lime and limestone: New York, Interscience Publishers, 520 p., illus., tables, 1966.

Some basic definitions of lime and limestone are given, and the history of their early use is summarized. One chapter is devoted to the formation and properties of limestone, including classification and geologic nomenclature. Limestone exploration and extraction are covered in another. Chapters on the use of limestone and analytical testing are included. Most of the remaining chapters are devoted to calcination, hydration, and manufacture and uses of lime.—E.S.L.

5374 **Brace, C. L.; Montagu, M. F. Ashley.** Man's evolution—An introduction to physical anthropology: New York, Macmillan Co., 352 p., illus., tables, 1965.

The textbook is divided into three parts. The general biological background is covered in the first, with chapters on organic continuity, principles of evolution, and taxonomy and primate classification. The second part is devoted to the fossil record, and divided into dating problems and the Cenozoic geological sequence, pre-Pleistocene primates, history of the discovery of fossils, stages of human evolution, and an interpretive summary of the fossil record. The last part covers living people. A glossary is included.—E.S.L.

5062 **Bradley, W. H.** Memorial to Levi Fatzinger Noble (1882–1965): Geol. Soc. America Bull., v. 77, no. 3, p. P49–P52, portrait, 1966.

5159 **Branson, Carl C.** Cyclicity in Oklahoma Paleozoic rocks, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 57–62, illus., table, 1964 [1966].

In Oklahoma, in the narrow platform area, the cyclical units are insufficiently developed and are too limited in distribution to warrant designating any as cyclothems. Areas of basinal facies are so predominant that Oklahoma geologists must use mapping units discriminated in the basin rocks and must fit the platform units into that section.—E.S.L.

5339 **Brant, Arthur A.** The promise of new geophysical tools, *in* Minerals Day collected papers: Skokie, Ill., Internat. Minerals and Chem. Corp., Mining and Explor. Div., p. 40–51, illus., 1965.

The first part of this paper outlines some fundamentals of geophysical exploration with their limitations, such as variations in anomalies and weakness in geological interpretation. The second part discusses some development attempts aimed at: quantitative interpretative systems that will solve an anomaly as to position and dimensions and physical property of the cause; reaching greater and greater depths; and more direct methods for detecting the economic material. The third part is a discussion of the immediate future evolution as one of improving data analyses and technique and instrument refinements, further stimulation to broad scale concepts of ore structural controls, and more effective drilling to depth.—G.D.C.

5203 **Brew, Douglas Crocker.** Stratigraphy of the Naco Formation (Pennsylvanian) in central Arizona [abs.]: Dissert. Abs., v. 26, no. 9, p. 5365–5366, 1966.

5130 **Briggs, Louis I.** Reply to Stringham's [1966] discussion [of "The hydraulic shape of sand particles" (1962)]: Jour. Sed. Petrology, v. 36, no. 1, p. 272, 1966.

Statements in the original paper (ibid., v. 32, no. 4, p. 645–656, 1962) were ambiguous. Stringham's criticism is correct, and his prediction of effects of change in shape alone were verified.—R.A.C.

Briggs, Louis I. *See* Haney, Warren D. 5165

5290 **Brooker, E. J.; Nuffield, E. W.** A general X-ray method for orienting a crystal: Acta Cryst., v. 20, pt. 4, p. 496–501, illus., tables, 1966.

A method for ascertaining the orientation of a randomly set crystal and adjusting it to a preferred orientation is described. Normal-beam, flat film rotation photographs yield data from which are calculated angles that define the directions of reciprocal lattice vectors with reference to the rotation axis and the planes of the goniometer arcs. The method of plotting the vectors reveals the principal zones and their orientation. The use of monochromatic radiation provides a quantitative estimate of the relative importance of each zone. Several advantages of the method are mentioned. It is particularly effective for low-symmetry crystals.—*from* Authors' abstract

Brooks, D. B. *See* Hawley, C. C. 5344

5319 **Brooks, David B.** Supply and competition in minor metals: Baltimore, Md., Johns Hopkins Press (for Resources for the Future), 147 p., illus., tables, 1965.

Minor metals differ from major metals in that most of them are mined as joint products and do not become independent economic goods until later stages of production. Their supply conditions are related primarily to the forms taken by joint production, which in turn are based on the geological conditions of occurrence and the stage of production at which minor metals become independent producers. The source materials referred to include both ore and byproduct. The minor metals are classified and distinguished from minerals. In detailed aspects this study is limited to the economics of minor metals in the United States, which is a major producer of source materials and primary products, and a major consuming nation.—G.D.C.

5406 **Brown, George D., Jr.; Lineback, Jerry A.** Lithostratigraphy of Cincinnatian Series (Upper Ordovician) in southeastern Indiana: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 1018–1023, illus., 1966.

Stratigraphic nomenclature of the Cincinnatian Series in southeastern Indiana is revised on a basis of lithologic criteria. The Cincinnatian Series consists of a complex of intertonguing rock types that is here divided into four formations, in ascending order: Kope, Dillsboro (new), Saluda, and Whitewater Formations.—A.E.R.

5222 **Brown, J. A.** Application of well logging to underground gas storage in western Kentucky, *in* Kentucky Oil and Gas Assoc., 28th Ann. Mtg., 1964, Tech. Sess. Proc.: Kentucky Geol. Survey, ser. 10, Spec. Pub. 10, p. 18–40, illus., tables, 1965.

The logging programs and interpretation methods used in the exploration for and the development of underground gas storage in western Kentucky are not unlike those used for primary production. It is the aim of this paper to present the logs and the major interpretation methods used by the storage companies. . . .—Author's abstract

5390 **Buerger, Martin K.; Taxer, Karlheinz.** Rhodizite—Structure and composition: Science, v. 152, no. 3721, p. 500–502, illus., 1966.

The mineral rhodizite could not be assigned a chemical formula on the basis of chemical analyses. The solution of the crystal structure reported here reveals that $CsB_{12}Be_4Al_4O_{28}$ is the ideal formula. The oxygen atoms occupy all but four sites per cell of cubic close packing whose period is 1/2 a. The boron, beryllium, and aluminum atoms occupy interstices of this array, the first two in tetrahedral coordination, the last in octahedral coordination. Together these atoms form a continuous network whose composition is $B_{12}Be_4Al_4O_{28}$, which should be neutral. The alkali atom is enclosed in a cage in this network and presumably is not behaving as an atom.—Authors' abstract

5377 **Buettner-Janusch, John.** Origins of man—Physical anthropology: New York, John Wiley and Sons, 674 p., illus., tables, 1966.

The book is divided into two major parts. The first contains a discussion of evolutionary theory and systematics and descriptions of man's fossil relatives and the major groups of living primates. Views held about the course of evolution of the entire order of primates are summarized. Part two is devoted principally to *Homo sapiens*, his culture, population, and biochemical genetics, and to the effect of evolution on human populations.—E.S.L.

Burchett, R. R. *See* Reed, E. C. 5177

Burckle, Lloyd H. *See* Heirtzler, J. R. 5394

5127 **Burger, John A.** Cyclic sedimentation in the Rock Springs Formation, Mesaverde Group, on the Rock Springs uplift, Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 55–63, illus., 1965.

An isopach map of the formation and a measured section of the Mesaverde Group accompany the discussion of the cyclothems and their environments.—E.S.L.

Burk, C. F., Jr. *See* Williams, Gordon D. 5351

Burke, W. H., Jr. *See* Wermund, E. G. 5309

5070 **Burnham, Charles W.** Evaluation of thermal parameters for silicon, aluminum and oxygen atoms in silicates [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 260, 1966.

5071 **Burns, Roger G.** Origin of pleochroism in "hypersthenes" [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 260–261, 1966.

5327 **Burns, Roger G.; Fuerstenau, Douglas W.** Crystal chemistry of manganese nodules from electron-probe measurements [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 261, 1966.

5010 **Burwash, R. A.; Baadsgaard, H.; Peterman, Z. E.; Hunt, G. H.** Precambrian, Chap. 2 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 14–19, illus., tables, 1966.

A seven-fold division of Precambrian time, based on K-Ar age determination, permits the mapping of regional time-rock units beneath and adjacent to the western Canada sedimentary basin, which are described according to the following time divisions: before 2,600 m.y.; 2,300 to 2,600 m.y.; 1,900 to 2,300 m.y.; 1,600 to 1,900 m.y.; 850 to 1,600 m.y.; 750 to 850 m.y.; and 600 to 750 m.y. Since the Hudsonian orogeny, most movements in the Precambrian complex of western Canada have been epeirogenic, isostatically positive arches dominantly granite gneiss; the western margin of the Churchill cratonic area has been the site of continuing sedimentation, with basaltic magmatic activity from 100 to 1,600 m.y. Intrusion and metamorphism, 750 to 850 m.y. ago, was apparently restricted to the Purcell terrain.—G.D.C.

5363 **Buzas, M. A.** The discrimination of morphological groups of *Elphidium* (Foraminifer) in Long Island Sound through canonical analysis and invariant characters: Jour. Paleontology, v. 40, no. 3, p. 585–594, illus., 1966.

The morphological groups *Elphidium incertum* (Williamson), *E. incertum* of Cushman, *E. clavatum* Cushman, *E. subarcticum* Cushman were compared by observing external morphology of representative populations from Long Island Sound. Results suggest that all but the second are distinct enough to be recognized as species. To test the hypothesis, the groups were discriminated on external morphology and eight characters by which groups are distinguished were measured and/or scored on 30 individuals from each. These variates were then compared along canonical axes. Further comparison was possible through consideration of presence or absence of organic inner lining and radial wall, and granular wall structure. All evidence indicates that these species are represented.—R.C.D.

Cabri, L. J. *See* Kracek, F. C. 4990

Calkins, Frank C. *See* Crittenden, Max D., Jr. 5110

5045 **Cameron, B. E. B.** Permian fauna from the Yukon Territory [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 450, 1965.

5425 **Canada Geological Survey.** Aeromagnetic map, Lac Palairet, Quebec: Canada Geol. Survey Geophysics Paper 2039, scale 1:63,360, 1965.

5426 **Canada Geological Survey.** Aeromagnetic map, Lac des Deux-Milles, Quebec: Canada Geol. Survey Geophysics Paper 2040, scale 1:63,360, 1965.

5427 **Canada Geological Survey.** Aeromagnetic map, Lac L'Epinay, Quebec: Canada Geol. Survey Geophysics Paper 2041, scale 1:63,360, 1965.

5428 **Canada Geological Survey.** Aeromagnetic map, Lac Indicateur, Quebec: Canada Geol. Survey Geophysics Paper 2042, scale 1:63,360, 1965.

5429 **Canada Geological Survey.** Aeromagnetic map, Lac Allenou, Quebec: Canada Geol. Survey Geophysics Paper 2051, scale 1:63,360, 1965.

5430 **Canada Geological Survey.** Aeromagnetic map, Lac Natipi, Quebec: Canada Geol. Survey Geophysics Paper 2052, scale 1:63,360, 1965.

5431 **Canada Geological Survey.** Aeromagnetic map, Lac Courtois, Quebec: Canada Geol. Survey Geophysics Paper 2053, scale 1:63,360, 1965.

5432 **Canada Geological Survey.** Aeromagnetic map, Rivière Epervanche, Quebec: Canada Geol. Survey Geophysics Paper 2054, scale 1:63,360, 1965.

5433 **Canada Geological Survey.** Aeromagnetic map, Lac de Sept-Milles, Quebec: Canada Geol. Survey Geophysics Paper 2063, scale 1:63,360, 1965.

5434 **Canada Geological Survey.** Aeromagnetic map, Lac Piacouadie, Quebec: Canada Geol. Survey Geophysics Paper 2064, scale 1:63,360, 1965.

5435 **Canada Geological Survey.** Aeromagnetic map, Lac Pambrun, Quebec: Canada Geol. Survey Geophysics Paper 2065, scale 1:63,360, 1965.

5436 **Canada Geological Survey.** Aeromagnetic map, Lac du Cran-Casse, Quebec: Canada Geol. Survey Geophysics Paper 2066, scale 1:63,360, 1965.

5437 **Canada Geological Survey.** Aeromagnetic map, Lac Brue, Quebec: Canada Geol. Survey Geophysics Paper 2075, scale 1:63,360, 1965.

5438 **Canada Geological Survey.** Aeromagnetic map, Lac à la Croix, Quebec: Canada Geol. Survey Geophysics Paper 2076, scale 1:63,360, 1965.

5439 **Canada Geological Survey.** Aeromagnetic map, Lac Aubin-Tellier, Quebec: Canada Geol. Survey Geophysics Paper 2077, scale 1:63,360, 1965.

5440 **Canada Geological Survey.** Aeromagnetic map, Lac Maublant, Quebec: Canada Geol. Survey Geophysics Paper 2078, scale 1:63,360, 1965.

5441 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 E/2, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3208, scale 1:63,360, revised 1966; originally published 1965.

5442 **Canada Geological Survey.** Aeromagnetic map, Pangertot Peninsula, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3510, scale 1:63,360, 1966.

5443 **Canada Geological Survey.** Aeromagnetic map, Cape Jones, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3511, scale 1:63,360, 1966.

5444 **Canada Geological Survey.** Aeromagnetic map, Thomson Island, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3525, scale 1:63,360, 1966.

5445 **Canada Geological Survey.** Aeromagnetic map, Rabbit Island, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3526, scale 1:63,360, 1966.

5446 **Canada Geological Survey.** Aeromagnetic map, Baker Foreland, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3527, scale 1:63,360, 1966.

5447 **Canada Geological Survey.** Aeromagnetic map, Kaminuriak Lake North, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3528, scale 1:63,360, 1966.

5448 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 M/3, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3529, scale 1:63,360, 1966.

5449 **Canada Geological Survey.** Aeromagnetic map, Banks Lake West, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3530, scale 1:63,360, 1966.

5450 **Canada Geological Survey.** Aeromagnetic map, Banks Lake East, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3531, scale 1:63,360, 1966.

5451 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 N/4, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3532, scale 1:63,360, 1966.

5452 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 N/3, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3533, scale 1:63,360, 1966.

5453 **Canada Geological Survey.** Aeromagnetic map, Peter Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3534, scale 1:63,360, 1966.

5454 **Canada Geological Survey.** Aeromagnetic map, Meliadine Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3535, scale 1:63,360, 1966.

5455 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 O/4, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3536, scale 1:63,360, 1966.

5456 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 O/3, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3537, scale 1:63,360, 1966.

5457 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 O/2, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3538, scale 1:63,360, 1966.

5458 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 M/5, District of Keewatin, Northwest Territories: Canada Geol. Suurvey Geophysics Paper 3539, scale 1:63,360, 1966.

5459 **Canada Geological Survey.** Aeromagnetic map, Parker Lake South, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3540, scale 1:63,360, 1966.

5460 **Canada Geological Survey.** Aeromagnetic map, MacQuoid Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3541, scale 1:63,360, 1966.

5461 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 M/8, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3542, scale 1:63,360, 1966.

5462 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 N/5, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3543, scale 1:63,360, 1966.

5463 **Canada Geological Survey.** Aeromagnetic map, Gibson Lake South, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3544, scale 1:63,360, 1966.

5464 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 N/7, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3545, scale 1:63,360, 1966.

5465 **Canada Geological Survey.** Aeromagnetic map, McManaman Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3546, scale 1:63,360, 1966.

5466 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 O/5, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3547, scale 1:63,360, 1966.

5467 **Canada Geological Survey.** Aeromagnetic map, Big Willow Bay, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3548, scale 1:63,360, 1966.

5468 **Canada Geological Survey.** Aeromagnetic map, Chesterfield Inlet, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3549, scale 1:63,360, 1966.

5469 **Canada Geological Survey.** Aeromagnetic map, Reindeer Lake South, Saskatchewan Manitoba: Canada Geol. Survey Geophysics Paper 7152, scale 1:253,440, 1966.

5470 **Canada Geological Survey.** Aeromagnetic map, Foster Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 7153, scale 1:253,440, 1966.

5471 **Canada Geological Survey.** Aeromagnetic map, Mudjatik, Saskatchewan: Canada Geol. Survey Geophysics Paper 7154, scale 1:253,440, 1966.

5472 **Canada Geological Survey.** Aeromagnetic map, La Loche, Saskatchewan: Canada Geol. Survey Geophysics Paper 7155, scale 1:253,440, 1966.

5473 **Canada Geological Survey.** Aeromagnetic map, Geikie River, Saskatchewan: Canada Geol. Survey Geophysics Paper 7156, scale 1:253,440, 1966.

5474 **Canada Geological Survey.** Aeromagnetic map, Cree Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 7157, scale 1:253,440, 1966.

5475 **Canada Geological Survey.** Aeromagnetic map, Lloyd Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 7158, scale 1:253,440, 1966.

5476 **Canada Geological Survey.** Aeromagnetic map, Reindeer Lake North, Saskatchewan: Canada Geol. Survey Geophysics Paper 7289, scale 1:253,440, 1966.

5275 **Cardwell, G. T.; Forbes, M. J., Jr.; Gaydos, M. W.** Progress report on the availability of fresh water, Lake Pontchartrain area, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 18, 24 p., illus., 1966.

A preliminary analysis of data collected during a study to evaluate sources of additional water supply in the New Orleans area indicates that either development of ground water beneath Lake Pontchartrain or development of surface water from the West Pearl and Tangipahoa Rivers to obtain a supply of 50–100 mgd is feasible from a hydrologic viewpoint. Data indicate that the potential combined yield of aquifers beneath the lake is relatively high. Large withdrawals should be limited to areas near the north shore to avoid the encroachment of salty water. Only minimal treatment would be required.—*from* Authors' abstract

5204 **Carpenter, Robert Heron.** A study of the ore minerals in cupriferous pyrrhotite deposits in the southern Appalachians [abs.]: Dissert. Abs., v. 26, no. 9, p. 5366, 1966.

5283 **Carr, Donald D.** Sand and gravel resources in eastern Johnson County and western Shelby County, Indiana: Indiana Geol. Survey Spec. Rept. 4, 19 p., illus., tables, 1966.

Eastern Johnson County and western Shelby County have large sand and gravel deposits which can furnish aggregate necessary for the future expansion of Indianapolis and adjacent areas. Evaluation of the Johnson County–Shelby County area as a potential source for aggregate must take into account such social–economic factors as transportation facilities, zoning regulations, present land use, and proximity to future markets and such geologic factors as composition and grain size of the materials, thickness of the deposits, and availability of water. On the basis of the above-mentioned factors, several selected places in this area are worthy of more detailed prospecting to locate the best sand and gravel deposits.—Author's abstract

Carter, N. L. *See* Christie, J. M. 5009

5205 **Cassie, Robert MacGregor.** The evolution of a domal granitic gneiss and its relation to the geology of the Thomaston quadrangle, Connecticut [abs.]: Dissert. Abs., v. 26, no. 9, p. 5367, 1966.

5142 **Cattermole, J. Mark.** Geologic map of the John Sevier quadrangle, Knox County, Tennessee: U.S. Geol. Survey Geol. Quad. Map GQ-514, scale 1:24,000, section, 1966.

Charlesworth, H. A. K. *See* Bielenstein, H. U. 5042

5317 **Chelini, J. M.** Index of unpublished geologic studies in Montana: Montana Bur. Mines and Geology Spec. Pub. 34, 88 p., illus., 1965.

This bibliography includes unpublished doctor and master theses. Part 1 lists theses indexed to maps in pocket and includes all studies for which specific locations were given in questionnaires and were amenable to outlining on a map; these are arranged according to college or university. Part 2 contains regional studies not plotted on the maps, and part 3, unreported known studies. It is hoped that information concerning the latter will be made available to the author.—M.C.M.

5072 **Chesterman, Charles W.** Vonsenite of Monterey County, California [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 261, 1966.

Christiansen, E. A. *See* Barton, Robert H. 5021

5009 **Christie, J. M.; Griggs, D. T.; Carter, N. L.** "Experimental deformation and recrystallization of quartz" and "Experimental evidence of basal slip in quartz"—A reply [to discussion of 1964 papers by D. S. Bhattacharyya, 1966]: Jour. Geology, v. 74, no. 3, p. 368–371, 1966.

Questions raised by Bhattacharyya (ibid., p. 366) are discussed by reiteration of evidences of basal slip and of slip directions given in the 1964 papers. Some more recent findings, to be published elsewhere, are outlined briefly.—R.E.W.

5160 **Chronic, John.** Nature and variability in Pennsylvanian sedimentary cycles of Colorado, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 63–68, illus., 1964 [1966].

Pennsylvanian cycles in Colorado are different from the typical cyclothems of central United States in consisting of coarse redbeds, finer-grained beds, marly shales, and limestones. Cycles average about 21 feet in the sections described, but range widely in thickness. The coarsest beds suggest a nonmarine origin, but the finer clastics and carbonate-rich beds are marine. Such widespread occurrence of cyclic deposits near areas of extreme tectonic movement suggests that the orogeny in Colorado was periodic in nature, and that its successive movements were at least partly the cause of cyclothems in central United States and perhaps elsewhere.—E.S.L.

5199 **Clark, D. L.; Ethington, R. L.** Conodonts and biostratigraphy of the Lower and Middle Devonian of Nevada and Utah: Jour. Paleontology, v. 40, no. 3, p. 659–689, illus., 1966.

Formations of Lower and Middle Devonian age in eastern and central Nevada, and in central and western Utah were studied and sampled at many localities. Significant conodont faunas were obtained from all formations sampled except the Sevy and Lone Mountain Dolomites. Age relationships interpreted from the faunal discoveries suggest that definite time lines can be projected from central Utah to central Nevada for part of the Paleozoic rocks and that these time lines cut across most of the formations.—R.C.D.

5313 **Clark, George B.; Ruppert, Gerald B.** Plane and spherical waves in a Voigt medium: Jour. Geophys. Research, v. 71, no. 8, p. 2047–2053, illus., 1966.

Analysis of displacement and strain relations for an existing solution of the plane Voigt wave equation indicates a behavior that may approximate field behavior of rocks near explosive sources more nearly than elastic waves for some frequencies. The peak strain for a plane Voigt wave is found to decay approximately as the distance $x^{-0.5}$. Pulse length also increases with distance. Displacement is nonoscillatory, increasing to a fixed value with time. A real time integral solution for the spherical Voigt equation is obtained by using Laplace transforms and appropriate operational procedures. This integral solution appears to be amenable to numerical evaluation by computer methods.—Authors' abstract

5314 **Clay, C. S.** Coherent reflection of sound from the ocean bottom: Jour. Geophys. Research, v. 71, no. 8, p. 2037–2046, illus., 1966.

The coherence of the reflections of acoustical radiation from the bottom was measured in the Grenada trough (off Martinique) and Hatteras abyssal plain. The roughness in the Grenada trench is estimated to be about 1 m and in the Hatteras abyssal plain as less than 0.4 m. Continuous seismic profiles were made to study the lateral uniformity of the bottom and sub-bottom layers. The similarity of reflection signals in the Hatteras abyssal plain indicates that the central part is reasonably uniform laterally; a similar experiment on the continental rise gave essentially no correlation. It is concluded that the roughness is associated with erosion and movement of sediments on the ocean bottom.—D.B.V.

Clay, D. N. *See* Bhattacharyya, B. K. 5372

5223 **Cobb, James C.** Iron meteorites with low cosmic ray exposure ages: Science, v. 151, no. 3717, p. 1524, table, 1966.

Analysis of argon-38 and argon-39 produced by cosmic rays in four iron meteorites gives normal amounts of the radioactive product argon-39 and abnormally low amounts of stable argon-38. This indicates that these meteorites were exposed to cosmic rays for unusually short periods of time. These exposure times are one or two orders of magnitude shorter than those for the average iron meteorite, and they overlap the periods found for chondrites. It is suggested that perhaps 20 percent of the iron meteorites have similarly short exposure periods.—Author's abstract

5380 **Cohen, L. H.; Klement, W., Jr.; Kennedy, G. C.** Investigation of phase transformations at elevated temperatures and pressures by differential thermal analysis in piston-cylinder apparatus: Jour. Physics and Chemistry Solids, v. 27, no. 1, p. 179–186, illus., 1966.

Differential thermal analysis (DTA) has proven to be among the more reliable and convenient of the several methods devised for the determination of phase boundaries at high pressures and temperatures. This paper discusses in detail the techniques, with the problems of materials design, and operation set forth and an assessment of the quality of data obtainable by DTA using piston-cylinder apparatus.—Authors' abstract

5145 **Colombo, U.; Denti, E.; Sironi, G.; Zimmer, E.** Contribution to the understanding of the natural evolution of petroleum—Radiation effects on crude oils [with French,

Russian, and Spanish abs.], *in* Internat. Conf. Peaceful Uses Atomic Energy, 3d, Geneva, 1964, Proc., V. 15: New York, United Nations, p. 402–411, illus., tables, 1965.

Geochemists and geologists agree that natural radioactivity from radioactive components of sedimentary rocks plays only a negligible role in the genesis of petroleum hydrocarbons. However, radiations may be of primary importance in the geochemical evolution of petroleum over geological periods. The authors believe that asphalt may be the product of radiation damage on hydrocarbons and similar organic materials. Irradiation experiments on crude oils from various sedimentary rocks of three Italian fields, and one in the Middle East, are described. In natural environments higher temperatures could enhance the alteration of crude oils. G.D.C.

Colquhoun, Donald J. *See* Ridgeway, David C. 5292

5094 **Cramer, Howard Ross; Falls, Darryl Lee.** A Mississippian shark from Dade County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 75, 1966.

5396 **Creely, Robert Scott.** Geology of the Oroville quadrangle, California: California Div. Mines and Geology Bull. 184, 86 p., illus., tables, geol. map, 1965.

Oroville quadrangle is in Butte County, athwart the border between the Sierra Nevada and the Sacramento Valley. The two stratigraphic sequences described are separated by a profound angular unconformity. Outcrops of the steeply dipping, metamorphosed "Bedrock series" are restricted to the eastern quarter of the area, the oldest unnamed, probably of late Paleozoic age, overlain by the Calaveras Formation and named units up to Late Jurassic age. The oldest rocks of the nearly flat "Superjacent series" are in the Upper Cretaceous Chico Formation above which are named units of Cenozoic age. The dominant structural features of the bedrock were accentuated during the Nevadan orogeny in the Late Jurassic. Mild uplift has occurred sporadically until recent times.—G.D.C.

5110 **Crittenden, Max D., Jr.; Calkins, Frank C.; Sharp, Byron J.** Geologic map of the Park City West quadrangle, Utah: U.S. Geol. Survey Geol. Quad. Map GQ–535, scale 1:24,000, sections, 1966.

Crockford, M. B. B. *See* Springer, G. D. 5349

5077 **Culbertson, William C.** Tongues of the Green River and Wasatch Formations in southeastern part of the Green River Basin, Wyo., *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 151–155, illus., 1965.

Geologic maps show the Luman and Tipton Tongues of the Green River Formation in the Great Divide and Washakie Basins, separated by the Niland Tongue of the Wasatch, but only the Tipton in the Green River Basin. The diversity of rock types in the southeastern part of the basin makes it difficult to determine what part should be assigned to the Luman. Columnar sections included in the paper show the Luman Tongue extending as far west as Pine Mountain, with 380 feet assigned to it at Little Mountain.—E.S.L.

5289 **Curl, Rane L.** Scallops and flutes: Cave Research Group Great Britain Trans., v. 7, no. 2, p. 121–160, illus., 1966.

Flow markings in cave channels are divided into scallops—irregular concavities—and the special case of flutes—regular, periodic, parallel crested patterns transverse to the flow direction. It is shown that flutes arise under conditions of long periods of constant flow velocity (solution rate) and that all stable solution flutes have a universal profile, downstream direction of propagation and Reynolds number of formation. A quantitative relation between flute period and flow velocity is proposed, the period being inversely proportional to velocity. Scallop patterns appear to be primarily due to variable flow conditions and are therefore less useful than flutes in estimating past flow conditions in caves, except for flow direction.

In both cases flow markings are only observed in channels carrying relatively rapid flow and are readily obscured, removed or prevented from forming by a variety of factors.—Author's abstract

Dalrymple, G. Brent. *See* Doell, Richard R. 5401

Danner, W. R. *See* McGugan, A. 5018

Davis, G. L. *See* Wetherill, G. W. 5364

5008 **Davis, Richard A., Jr.** Revision of Lower Ordovician nomenclature in the upper Mississippi Valley: Jour. Geology, v. 74, no. 3, p. 361–365, illus., 1966.

Study of more than 40 exposures of the largely carbonate rock sequence between the Jordan Sandstone at the base and the St. Peter Sandstone at the top indicated need for revision of stratigraphic nomenclature of the Lower Ordovician Prairie du Chien Group. The Prairie du Chien is divided into the Oneota Dolomite (about 200 feet thick) below, and the Shakopee Formation above; the Shakopee Formation is subdivided into the New Richmond Sandstone Member (2–48 feet thick) below, and the Willow River Dolomite Member (0–300 feet thick) above.—V.E.S.

5039 **Davis, Stanley N.; DeWiest, Roger J. M.** Hydrogeology: New York, John Wiley and Sons, 463 p., illus., tables, 1966.

Contents of this textbook are: introduction; hydrologic cycle; physical and chemical properties of water; water quality; radionuclides in ground water; elementary theory and applications of ground-water flow; exploration for ground water; ground water in igneous, metamorphic, and sedimentary rocks; ground water in nonindurated sediments and in regions of climatic extremes. The book is a companion volume to *Geohydrology* by DeWiest, which emphasized the hydrologic or fluid-flow aspects of ground water; the overlap of the two books is confined to the introduction and to chapters dealing with fluid flow. However, extensive revisions have been made so that many overlap sections are entirely different from each other. Each chapter has an extensive reference list.—M.C.M.

DeLaney, A. Otis. *See* Englund, Kenneth J. 5144

DeLaney, A. Otis. *See* Englund, Kenneth J. 5251

5281 **delaTorre, Jorge; Frederickson, Arman F.** Clay-mineral distribution in recent sediments from northern Pacific Coast of Mexico [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 637–638, 1966.

5044 **Delorme, D. L.** A stratigraphic study of the Regina Basin, Saskatchewan [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 450, 1965.

5027 **Dennison, John M.** Reliability of visual estimates of grain abundance: Jour. Sed. Petrology, v. 36, no. 1, p. 81–89, illus., 1966.

The reliability of visual estimates of relative proportions of minerals in a particle aggregate was found to be not significantly affected by differences in particle composition, by color or composition of background material, by relative differences in academic training of geologists, or by use or non-use of a visual comparison chart. A point count of 16 points gives a level of precision equal to that of the visual estimates. A point count of 64 points gives a level of precision that is twice as high as that of the visual estimates. A 95 percent level of significance is applied to the results of the graeco-latin square and analysis of variance tests of the 384 different visual estimates used in the study.—R.A.C.

5414 **DeNoyer, J. M.** S waves generated by small seismic sources: Royal Soc. [London] Proc., ser. A, v. 290, no. 1422, p. 448–460, illus., tables, 1966.

Observations of S waves from small near earthquakes indicate that the relative S-wave generation extends over a wide range. Similar measurements from underground explosions indicate a ratio of S- to P-wave generation below values

observed for 70 percent of the earthquakes. Teleseismic observations of S waves from small events is complicated by interference of microseisms and by the physical requirement of two horizontal component seismographs to obtain good resolution of S wave motion. Results obtained with three component seismometers in arrays suggest that improvements in S wave signal to noise ratios similar to those obtained for P waves are possible. The use of S waves for small events at teleseismic distances has no value as a detection method, but offers promise as an added method of identification of small seismic events.—D.B.V.

Denti, E. *See* Colombo, U. 5145

5146 **Desborough, George A.** The significance of accessory magmatic sphalerite in basic rocks to the origin of nickeliferous pyrrhotite ores: Econ. Geology, v. 61, no. 2, p. 370–375, 1966.

The ratio of Zn:Ni and Zn:Cu in basaltic rocks is not consistent with these ratios in Ni pyrrhotite ores considered to be of immiscible segregation (magmatic) origin, in view of the fact that sphalerite occurs as a minor constituent associated with chalcopyrite and pyrrhotite in basaltic rocks and norites. If the magmatic origin is to be accepted for the so called magmatic Ni pyrrhotite ores, the low Zn:Ni and Zn:Cu ratios of these ores must be explained. Likewise, any other mode of origin for these ores must explain their relatively low Zn concentrations.—Author's abstract

5250 **DeVoto, Richard H.** Pennsylvanian and Permian stratigraphy of central Colorado: Mtn. Geologist, v. 2, no. 4, p. 209–228, illus., tables, 1965.

Tectonic activity, mainly faulting, in the Pennsylvanian formed two major mountainous land masses and associated depositional basins in central Colorado. Marine shales of the Belden Formation accumulated in the trough between the land masses while the Kerber Formation coals and nonmarine shales and sandstones were deposited to the south in the Morrowan. The Coffman beds, raised to formation rank here, represent littoral sandstone facies deposited between the neritic, black shales of the Belden and the coastal plain redbeds of the Maroon during early Des Moinesian. The Maroon Formation continued to accumulate and encroach on the Front Range during Pennsylvanian and early Permian and the Garo Sandstone of Permian age was deposited along the shoreline of a restricted basin within the trough in South Park.—*from* Author's abstract

DeWiest, Roger J. M. *See* Davis, Stanley N. 5039

5073 **Dickinson, S. K., Jr.** The chemical erosion of diamond by boron—An analogy to graphitization [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 262, 1966.

4985 **Dietrich, R. V.** Further considerations of the apparent dearth of K feldspars with intermediate Δ values [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 262, 1966.

5132 **Dixon, Mark A.** Discussion of article "Transformation of weight frequency and number frequency data in size distribution studies of clastic sediments" by Basanta K. Sahu [1964]: Jour. Sed. Petrology, v. 36, no. 1, p. 273–274, 1966.

Mathematical transformations described in the original paper (ibid., v. 34, p. 768–773, 1964) do not account for the deviation of the mean, or bias unique to transformation of loose grain data. The actual experiment reported by Sahu suggests no bias, but any attempt to extrapolate from the total measured populations of 10 grains to a much larger population would introduce statistical difficulties.—R.A.C.

Dodge, F. C. W. *See* Kistler, R. W. 5302

5401 **Doell, Richard R.; Dalrymple, G. Brent.** Geomagnetic polarity epochs—A new polarity event and the age of the Brunhes Matuyama boundary: Science, v. 152, no. 3725, p. 1060–1061, illus., 1966.

Recent paleomagnetic-radiometric data from six rhyolite domes in the Valles Caldera, New Mexico, indicate that the last change in polarity of the Earth's magnetic field from reversed to normal (the Brunhes–Matuyama boundary) occurred at about 0.7 m.y. ago. A previously undiscovered geomagnetic event, herein named the "Jaramillo normal event", occurred about 0.9 m.y. ago.—Authors' abstract

5098 **Dorman, LeRoy M.; Husted, John E.** Crustal studies in southeastern U.S.—Preliminary studies [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 76, 1966.

5402 **Dott, R. H., Jr.** Superimposed rhythmic stratigraphic patterns in mobile belts, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 69–85, illus., tables, 1964 [1966].

Rhythmic deposition has occurred in mobile belts as well as on cratons. Worldwide oscillations affect both regions, but in mobile belts are obscured by local, more or less rhythmic, effects. Examples are described from the Pennsylvanian in the Great Basin, Cretaceous in the Rocky Mountains, and Cretaceous-Tertiary of the Pacific Coast. Interrelationships of the causal factors are discussed, including long-period cycles and oceanic warping.—E.S.L.

Dowling, J. J. *See* Hales, A. L. 5108

5422 **Downs, George R.; Bird, Allan G.** The Schwartzwalder uranium mine, Jefferson County, Colorado: Mtn. Geologist, v. 2, no. 4, p. 183–191, illus., 1965.

The mine is the largest vein-type uranium producer in the State and sixth largest in the country. Ore shipments of 133,000 tons 0.78 percent average grade ore have yielded over 2 million lbs U_3O_8 and unmined reserves are believed to exceed the amount already produced. The orebody is a typical hydrothermal vein-type deposit with primary pitchblende as the principal ore mineral. Host rocks are units of Idaho Springs Formation of Precambrian age, with ore deposition occurring early in the Tertiary. The fissure veins are located 400 yd southwest of and parallel to the Rogers breccia reef, a Laramide fault of large displacement. Repeated movement along this major fault resulted in fracturing and rebrecciation of the fissures of the mine area, providing channels for entry of the mineralizing fluids.—*from* Authors' abstract

Duncan, Wilbur H. *See* Stanley, Edward A. 5090

Durden, C. J. *See* Vogel, B. R. 5201

Dutro, J. Thomas, Jr. *See* Ross, Reuben James, Jr. 5135

5224 **Dymond, Jack R.** Potassium-argon geochronology of deep-sea sediments: Science, v. 152, no. 3726, p. 1239–1241, illus., table, 1966.

A potassium-argon dating method applicable to small quantities of volcanic minerals and glass has been developed and used to determine the ages of North Pacific sediments. Tertiary sedimentation rates range from less than 1.0 millimeter per 10^3 years for deep-sea "red clay" to 1 centimeter per 10^3 years for calcareous-siliceous ooze nearer the continent. The potassium-argon ages obtained from different minerals are concordant, and in samples with associated fossils, these ages are compatible with the paleontological evidence.—Author's abstract

5154 **Fast, Edwin H.** Structure and stratigraphy of San Francisco Mountains, western Utah: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 901–920, illus., 1966.

Prospect Mountain Quartzite of Cambrian age is thrust over Paleozoic rocks as young as the Ely Limestone of Pennsylvanian age. The quartzite of the allochthonous plate was believed to be Ordovician-Silurian(?) and had been named Morehouse Quartzite. Overlying rocks are volcanics of Tertiary age. The San Francisco thrust is compared with similar thrusts in the Wah Wah Mountains and the Canyon Range and possibly formed in Late Jurassic(?) and Early Cretaceous.—E.K.M.

5295 **Eicher, Don L.** Foraminifera from the Cretaceous Carlile Shale of Colorado: Cushman Found. Foram. Research Contr., v. 17, pt. 1, p. 16–31, illus., 1966.

Twenty-six species of foraminifers including two new, *Ammobaculoides macellus and Ammomarginulina perimpexus*, are described from a section of Carlile Shale at Rock Canyon, west of Pueblo, Colo. The three members of the Carlile show distinct faunas: Fairport Shale, of Middle Turonian age, has mainly calcareous planktonic species, dominated by *Hedbergella delrioensis*, decreasing in abundance and variety upward; the Blue Hill Shale has mainly arenaceous species, decreasing upward as the shale becomes silty; the Codell Sandstone contains burrows suggesting very shallow water, but is capped by a 2-ft marine shale with mixed calcareous and arenaceous fauna. Except for the top shale, vertical changes in the Carlile fauna indicate progressive shallowing of a regressive sea.—V.M.J.

5099 **Eichholz, G. G.; Batum, Ozen.** Analysis of minerals by neutron activation analysis [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 68, 1966.

Einarsson, Thorleifur. *See* Hopkins, D. M. 5415

5161 **Elias, Maxim K.** Depth of late Paleozoic sea in Kansas and its megacyclic sedimentation, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 87–106, illus., 1964 [1966].

Evidence of larger Foraminifera and stromatolite-forming algae as to depth of seas is reviewed. The ventricose fusulinid phase of the Beattie cyclothem probably represents the culmination of marine invasion, and the elongate fusulinids found at the top of the Cottonwood and base of the Florena represent retreat of the sea. Geologic and hydrologic considerations demand that the Kansas Sea attained greater depths at the climaxes of the late Pennsylvanian–early Permian invasions than the currently suggested 80 feet. An alternative reconstruction of the Kansas Sea at Beattie time is the mechanism of "staggering" oceanic transgressions over existing continental seas. An interpretation of the Shawnee megacyclothems is based on this theory.—E.S.L.

5293 **Ellison, Robert L.** Stratigraphy and paleontology of the Mahantango Formation in south-central Pennsylvania: Pennsylvania Geol. Survey Bull. G 48 (Gen. Geology Rept.), 298 p., illus., tables, 1965.

Field and laboratory studies indicate that the wedge of clastic sediments comprising the Devonian Mahantango Formation may be divided into three units, which pass vertically and laterally into one another. The basal contact of the formation with the Marcellus Formation is gradational, and the upper part interfingers with Tully sediments. Systematic descriptions are given of species in the six phyla found in the Mahantango; faunas are dominated by brachiopods. Descriptions of 18 of the most complete seetions are included, and three sections showing stratigraphic relationships accompany the paper.—E.S.L.

5102 **Ely, Northcutt.** The present contour of the world's mining and petroleum legislation, *in* Minerals Day collected papers: Skokie, Ill., Internat. Minerals and Chem. Corp., Mining and Explor. Div., p. 84–92, 1965.

When the development of modern technology made exploitation of submarine resources feasible, and geological exploration revealed the probable existence of rich off-shore mineral deposits, legal problems complicated their exploitation. A new legislative pattern is taking place on a world-wide scale regarding mineral rights, especially the geographic expansion to include the submerged continental shelf beyond the limits of territorial waters, even deep parts of the slope. The possible resources in various offshore parts of the world and recent development of mineral industry are discussed briefly.—G.D.C.

5144 **Englund, Kenneth J.; DeLaney, A. Otis.** Geologic map of the Sandy Hook quadrangle, Elliott and Morgan Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-521, scale 1:24,000, section, text, 1966.

Coal in the Sandy Hook quadrangle is of high volatile A or B bituminous rank, and occurs in at least 16 beds (principally in the Breathitt Formation), which vary from about 12 to 17 inches thick. Nearly all mines are abandoned, but exploration of the Laurel bed which is relatively thick may disclose areas of economic importance. Drilling in the Sandy Hook quadrangle has not resulted in any significant oil or gas production; prospects are good in the vicinity of a dome near the west edge of the map area. Of potential importance are refractory clay and limestone.—M.C.M.

5251 **Englund, Kenneth J.; DeLaney, A. Otis.** Geologic map of the Bruin quadrangle, Elliot and Carter Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-522, scale 1:24,000, section, text, 1966.

Coal of high volatile A or B bituminous rank occurs in one discontinuous bed in the lower Lee Formation and in at least 12 beds of more widespread distribution in the Breathitt Formation. A few small mines operate seasonally. Oil and gas production is confined to a small area in the southeast. Flint clay has been mined from the Olive Hill Clay Bed and the Newman Limestone contains limestone suitable for aggregate and road metal.—M.C.M.

5411 **Englund, Kenneth J.** Geologic map of the Ketchen quadrangle, Tennessee-Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-500, scale 1:24,000, section, text, 1966.

The only mineral resource development in the Ketchen quadrangle is intermittent coal mining during the past 60 years. Of the estimated original reserves for beds of 14 inches or more (345 million tons), less than one percent has been mined. Low folds in the southeast may reflect subsurface structures favorable for oil or gas accumulation. The Hance, Mingo, Catron, and Hignite Formations are reduced to the rank of members to conform with current usage of the Breathitt as a formation. Coal bed nomenclature consists largely of local names and most beds have been traced from their type localities.—M.C.M.

5381 **Esterbrook, D. J.** Radiocarbon chronology of Late Pleistocene deposits in northwest Washington: Science, v. 152, no. 3723, p. 764-767, illus., table, 1966.

Fourteen radiocarbon dates of shells and wood from late Pleistocene sediments in northwest Washington provide evidence for correlation of the Everson interstadial with the Two Creeks interval of the midcontinent and suggest possible correlations between the Sumas and Valders stadials and between the Vashon stadial and part of the Tazewell-Cary advances.—Author's abstract

Ethington, R. L. *See* Clark, D. L. 5199

5367 **Evans, Bernard W.; Guidotti, Charles V.** The sillimanite-potash feldspar isograd in western Maine, U.S.A.: Contr. Mineralogy and Petrology, v. 12, no. 1, p. 25-62, illus., tables, 1966.

Minerals from pelitic schists below and above the sillimanite-potash feldspar isograd in Bryant Pond and adjacent quadrangles in western Maine were analyzed to determine those in the reaction, how the reaction should be expressed; to explain the wide distribution of the muscovite-sillimanite-orthoclase-plagioclase assemblage, the influence of plagioclase on the isograd, and any regional distribution of feldspar and muscovite compositions; to examine the equilibrium reached; and to interpret results in light of equilibrium data. The equilibrium phase diagram considered in light of probable variability in rock compositions indicates that the Sill-Or-Ms-Plag-Q assemblage is univariant in P and T, and some other normally independent intensive variable, possibly PH_2O, is subject to control, or temperature gradients above the isograd were minimal because of fractional melting and T was no longer a variable.—V.S.N.

5206 **Fair, Charles Leroy.** Geology of the Fresnal Canyon area, Baboquivari Mountains, Pima County, Arizona [abs.]: Dissert. Abs., v. 26, no. 9, p. 5367, 1966.

Falls, Darryl Lee. *See* Cramer, Howard Ross. 5094

5188 **Faul, Henry.** Tektites are terrestrial: Science, v. 152, no. 3727, p. 1341–1345, illus., 1966.

Geochronologic evidence indicates that tektites were formed from terrestrial rocks in large meteoritic impacts on the Earth. Ivory Coast tektites were formed about 1.3 m.y. ago, simultaneously with the Bosumtwi crater. Moldavites were formed 14.8 m.y. ago, simultaneously with the Ries crater. North American tektites were formed 35 m.y. ago, but no crater is known to be associated with them.—Author's abstract

5420 **Faulkner, Edward Leslie.** The distribution of cobalt and nickel in some sulphide deposits of the Flin Flon area, Saskatchewan [abs.]: Dissert. Abs., v. 26, no. 9, p. 5367–5368, 1966.

5412 **Faulkner, R. L.; McVey, W. H.** Fuel resources and availability for civilian nuclear power, 1964–2000 [with French, Russian, and Spanish abs.], *in* Internat. Conf. Peaceful Uses Atomic Energy, 3d, Geneva, 1964, Proc., V. 12, Nuclear fuels—[Pt.] 3, Raw materials: New York, United Nations, p. 11–20, tables, 1965.

Exploration and development of new uranium deposits has virtually stopped in the United States and other major producing countries since 1960. By 1964 estimated world reserves had declined from a peak of over a million to 600,000 tons; annual production is expected to decline from the present 20,000 tons to 14,000 by 1970 when projected nuclear power growth will then require new production. Estimated reserves in 1971 are 96,000 tons for U.S.A., 188,000 for Canada, 134,000 for South Africa, 56,000 for others. For the United States a short-term potential of 65,000 tons has been estimated. Much larger estimates can be given for both uranium and thorium at increased prices up to five hundred dollars per pound. Low-cost thorium should be amply available in the next 35 years.—G.D.C.

4986 **Field, W. G.** X-ray diffraction at ultra-high pressure and temperature [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 263, 1966.

5237 **Finch, Warren I.; Minard, James P.** Geologic map of the Farmington quadrangle, Graves County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-530, scale 1:24,000, section, text, 1966.

The chief geologic resources of the Farmington quadrangle are clay from the Eocene Claiborne(?) Formation, extensive gravel from the continental deposits, and ground water from the Claiborne(?).—M.C.M.

Finnegan, Stephen. *See* Goldsmith, Werner. 5312

Fisher, W. L. *See* Rodda, Peter U. 5119

5162 **Fisher, W. L.** Sedimentary patterns in Eocene cyclic deposits, northern Gulf Coast region, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 151–170, illus., table, 1964 [1966].

Eocene depositional cycles are the result of repeated strand transgressions and regressions occurring within a basin similar to the present Gulf. Details of cycles, shown best in Claiborne sequences, are described. The transgressive phase includes open marine glauconitic sands and marls overlain by marginal marine clays. The regressive phase consists of a basal arenaceous unit representing fluvial to marginal marine deposition, and an upper argillaceous carbonaceous unit. Cyclic features provide a basis for classification of the Gulf Coast Eocene.—E.S.L.

5291 **Fisher, W. L.** Geology of the Texas Gulf Coastal Province: Interstate Oil Compact Comm. Comm. Bull., v. 7, no. 2, p. 18–22, 1965.

Beneath the 200–500 mi width of the Texas Gulf Coastal Plain, 500,000 cu mi of Mesozoic and Cenozoic sediments rest upon a complex of folded and variously metamorphosed Precambrian and Paleozoic rocks. Regional dip of relatively

undeformed strata is interrupted by warpings, faults, and igneous and salt intrusions. The Balcones Fault System or the contact of Lower and Upper Cretaceous rocks define the inner margin of the Province. Production of oil and gas from all age rocks, from near surface to over 20,000 ft depths, and from a great variety of traps and reservoirs is outlined. Of the 15 major fields 82 percent produce from Cenozoic rocks, mostly Frio; about 60 percent are associated with salt structures. The East Texas field, with discovered reserves of about 5 billion bbl, is by far the largest.—G.D.C.

5383 **Flint, Norman K.** Geology and mineral resources of southern Somerset County, Pennsylvania: Pennsylvania Geol. Survey Bull. C56A (County Rept.), 267 p., illus., tables, geol. map, 1965.

Somerset County is adjacent to Maryland in the eastern part of the Allegheny Plateau. Outcropping strata range in age from Upper Devonian to Pennsylvanian, and are described in detail and shown in sections. Total thickness is about 8,000 feet. A cross-bedding and paleocurrent study of the sandstones is presented. Two changes in nomenclature are introduced in the Mauch Chunk Formation limestones, and the Conemaugh is divided into two formations and raised to group rank. The area contains a system of relatively open anticlines and synclines. Mineral resources include coal, clay, limestone, sandstone, shale, and natural gas. Reserve maps show coal remaining in at least 11 beds. An isopach map of the Deer Valley Limestone accompanies the report.—E.S.L.

5113 **Florida Division of Geology.** Sunoco-Felda field—Well location and land map, Hendry and Collier Counties: [Tallahassee] Florida State Board Conserv., scale about 1 in to 2,000 ft, 1966.

Forbes, M. J., Jr. *See* Cardwell, G. T. 5275

5091 **Forbes, Warren C.; Giardini, A. A.** Petrographic study of ruby bearing nodules from Habersham County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 73–74, 1966.

5376 **Foster, Robert J.** Geology: Columbus, Ohio, Charles E. Merrill Books (Merrill Physical Science Series), 138 p., illus., tables, 1966.

This textbook for college level is divided into four chapters: (1) composition of the crust (elements, minerals, and rocks); (2) external processes—erosion (mass wasting or movement; geologic work of rivers, wind, and ice; and ground water); (3) structural geology (internal structure of the Earth and structure of the crust); and (4) historical geology. Each chapter includes study questions and a list of selected references.—M.C.M.

5294 **Fox, Richard C.** Chorda tympani branch of the facial nerve in the middle ear of tetrapods: Kansas Univ. Mus. Nat. History Pub., v. 17, no. 2, p. 15–21, 1965.

Neontological and paleontological studies of the middle ear of tetrapods are reviewed, and evolution of the path of the chorda tympani branch with relation to the tympanic and quadrate processes of the stapes and the articulation of the jaw is traced, according to Hotton (1960) and others, from amphibians through reptiles to mammals. Hotton believes that the captorhinomorphs and synapsids have given rise to all living mammals and reptiles, with possible exception of turtles, whose ancestry is obscure.—V.M.J.

5320 **Fox, Richard C.; Bowman, Merton C.** Osteology and relationships of *Captorhinus aguti* (Cope) (Reptilia, Captorhinomorpha): Kansas Univ. Paleont. Contr. [41], Vertebrata, art. 11, 79 p., illus., table, 1966.

The osteology of *Captorhinus aguti* (Cope) [Lower Permian of Tex., N. Mex., Okla.] is discussed, and the attachment of the major appendicular muscle groups is interpreted. Speciation in *Captorhinus*, position of this genus among the Captorhinomorpha, evolution of the middle ear in captorhinomorphs and their derivatives, and the question of relationships . . . are analyzed. It is concluded that microsaurs have no relationship to captorhinomorphs and that a basic

captorhinomorph–pelycosaur stock arose from embolomeres without seymouriamorphan intermediates.—Authors' abstract

Frederickson, Arman F. *See* delaTorre, Jorge. 5281

5310 **Friedman, Irving; Smith, Robert L.; Long, William D.** Hydration of natural glass and formation of perlite: Geol. Soc. America Bull., v. 77, no. 3, p. 323–327, illus., 1966.

The rate of hydration of rhyolitic glass from 5° to 100°C is expressed by the relation $x^2 = kt$ where x is depth of hydration in microns and t is time in years; k varies from 0.4 at 5°C to 10^4 at 100°C and is independent of water pressure up to 1 atm PH_2O. The activation energy is about 20 kcal/mole.—J.J.H.

Friedman, Irving. *See* Graf, Donald L. 5392

Fries, Carl, Jr. *See* Valencia, Josefina. 5266

5418 **Fries, Carl, Jr.; Rincón-Orta, César.** Contribuciones del Laboratorio de Geocronometria—Pt. 2, Nuevas aportaciones geocronológicas y técnicas empleadas en al Laboratorio de Geocronometria: México Univ. Nac. Autónoma Inst. Geología Bol. 73, p. 57–133, illus., tables, 1965.

Twenty-six absolute age determinations are reported, carried out since those reported by Fries in 1962, on rocks from the metamorphic basement of northeastern Hidalgo and Oaxaca, the Acatlan Formation of Puebla, the Acapulco Granite, metamorphic rocks of west-central Tamaulipas, granodiorite and adularia from veins in northeastern Zacatecas, metamorphic rocks of northern Zacatecas, Sonobari Complex of Sinaloa, and intrusives of northern and northeastern Sonora. The oldest age is 1,210±140 m.y. for gneiss in Hidalgo. Pegmatites and the Acatlan Formation in Oaxaca and Mexico are from 670±20 to 960±110 m.y. and 448±175 m.y., respectively; whole rock ages for the Coapas Schist in Zacatecas range from 165±40 to 220±30 m.y.; and various monzonite, granite, and pegmatite intrusives in Sinaloa and Sonora range in age from 33.3±1 to 70±3? m.y.—V.S.N.

5262 **Frosch, R. A.; Green, P. E., Jr.** The concept of a large aperture seismic array: Royal Soc. [London] Proc., ser. A, v. 290, no. 1422, p. 368–384, illus., 1966.

Arrays of seismometers may enhance the signal-to-noise ratio of distant seismic events over the single-instrument signal-to-noise ratio and suppress signal-generated noise arising in the crust below the receiver; buried instruments frequently have lower noise environment than surface instruments, and borehole emplacement may be particularly effective against wind-generated noise. A large aperture array, consisting of more than 500 seismometers in 21 clusters over a 200-km aperture, is being constructed for maximum exploitation of these possible improvements; this array and some of its possibilities for world-wide seismological detection systems are described.—D.B.V.

Fuerstenau, Douglas W. *See* Burns, Roger G. 5327

Fuller, J. G. C. M. *See* Porter, J. W. 5015

5338 **Furrazola-Bermúdez, Gustavo; Judoley, Constantino M.; Mijailóvskaya, Marina S.; Miroliubov, Yuri S.; Novojatsky, Ivan P.; Nuñez Jimenez, Antonio; Solsona, Juan B.** Geología de Cuba: Havana, Inst. Cubano Recursos Minerales, 239 p., illus., tables, geol. map, separate appendix of maps, sections and charts, 1964; English text (Translations on Cuba, No. 311), Washington, D. C., U.S. Dept. Commerce Clearinghouse Federal Sci. and Tech. Inf. (JPRS 32,325) 254 p., illus., 1965.

The geologic history of Cuba and adjacent regions is grouped in three time divisions: a Lower-Middle Jurassic great depression; Upper Jurassic to middle Eocene deformation and volcanism, with mineralization; and middle Eocene to Recent decrease of folding, no magmatism, and with vertical faulting. Prolonged emergence, first on the geosynclinal margin, formed Pinar del Rio and Island of Pines; later, Trinidad. Deep Cretaceous(?) faults exist along edges of structural facies; later faults

border the Central Basin and other depressions. Early facies were terrigenous with some salt; later, carbonates predominated, with facies of volcanic origin in intrageosynclinal depressions. Rejuvenation of magmatism occurred from northwest to southeast. Assumptions on geotectogenesis and formation of Cuba are based on continental drift and contraction.—G.D.C.

Gabelman, J. W. *See* Nininger, R. D. 5404

4987 **Gaines, A. M.; Perrotta, A. J.; Stephenson, D. A.** A phenacite-spinel inversion in lithium aluminum germanate [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 263, 1966.

5243 **Galle, O. Karmie; Waugh, Wanda N.** Compositional variance in the Plattsmouth Limestone Member (Pennsylvanian) in Kansas: Kansas Geol. Survey Bull. 180, pt. 1, p. 1–9, illus., tables, 1966.

The compositional variance of this member of the Oread Limestone was studied with respect to the distance between sample locations. Nine samples spaced 150 to 200 feet apart, collected from an underground quarry in Atchison County and compared with 11 outcrop samples spaced six miles apart, indicate that variances are 95 percent equal. It is concluded that chemical data can be used to depict trends within the Plattsmouth Limestone Member, sampled as much as six miles apart; that samples should be collected and analyzed before economic development is begun; and that results of this study may be applied to many limestones of Pennsylvanian age from the Midcontinent area.—*from* Authors' abstract

5271 **Gans, Carl; Parsons, Thomas S.** On the origin of the jumping mechanism in frogs: Evolution, v. 20, no. 1, p. 92–99, 1966.

In many groupings of early amphibians, the adult stages show trends toward a relatively short-coupled body form, with sizable legs that extend laterally and cantilever the trunk between them. It is not clear what produced the adaptive trends that led to shortening of the trunk. Although the fossil record is incomplete, the authors favor a riparian origin of frogs, along the shores of small bodies of fresh water. Saltation probably developed as an escape mechanism, possibly also used in catching prey, and not necessarily interfering with lateral undulatory locomotion but adaptable to aquatic locomotion. Theories of other workers are evaluated.—G.D.C.

5397 **Garcia Gutierrez, Carlos.** Las tektitas: Geologia y Metalurgia, v. 2, no. 14, p. 33–38, 1965.

The appearance, geographic distribution, abundance, chemical composition, physical properties, structure, and origin of tektites (extraterrestrial or terrestrial) are reviewed very briefly.—V.S.N.

5005 **Gardiner, M. J.; Odell, R. T.; Hallbick, D. C.** Poorly drained soils and geomorphology of Glacial Lake Douglas in Illinois: Jour. Geology, v. 74, no. 3, p. 332–344, illus., 1966.

Glacial Lake Douglas occupied a shallow depression about 85 sq mi in area in the ground moraine of the Wisconsin glaciation in Douglas County. Soils are developed mainly in a 3 to 4-ft mantle of loess overlying the lacustrine clays, silts and sands, which in turn overlie the Wisconsin till. Lakebed soils are higher in clay and sand, lower in silt and organic carbon, and have higher bulk densities than other similarly poorly drained soils in the vicinity, such as the Drummer silty clay loam.—R.E.W.

Gaulow, R. *See* Blum, P. A. 5424

Gaydos, M. W. *See* Cardwell, G. T. 5275

5081 **Gazin, C. Lewis.** Early Eocene mammalian faunas and their environment in the vicinity of the Rock Springs uplift, Wyoming, *in* Sedimentation of Late Cretaceous

and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 171–180, illus., 1965.

Early Eocene collecting localities are scattered over a relatively large area of the basins adjoining the Rock Springs uplift. Sixteen mammalian faunal occurrences are described and the recognized forms listed for each. A discussion of their environment concludes the paper.—E.S.L.

5285 **Gelabert, P. A.; Alonso, R. M.** Preliminary report on the sand resources of northeastern Puerto Rico: Puerto Rico Dept. Public Works Geol. Inv. Bull. 9, 48 p., illus., tables, 1965.

In Puerto Rico sands occur as both residual and transported deposits. Residual sandy soils are in granitic areas of the central part of the island; some deposits are exploited privately on a small scale, but transportation costs and other problems hamper development. Transported soils are terrestrial (river, deltaic, and lagoonal), with reserves estimated at 22,830,000 m^3; and marine (beach and submarine). Beach deposits have been the primary source of sand for construction purposes; shallow sand banks behind barrier reefs have excellent potential but extraction and transportation problems must be solved. Increased construction is reducing the island's stockpile of sand and gravel and recommendations are presented for control and conservation.—M.C.M.

5419 **Gerhard, Lee C.; Wahlstedt, Warren J.** Milsap Creek fault block—A gravitational structure: Mtn. Geologist, v. 2, no. 4, p. 203–208, illus., 1965.

Gravitational tectonics provides solutions to a number of structurally complex areas in the Rocky Mountain region. The Milsap Creek area of the Canon City embayment, Colorado, is one such area. Gravitational sliding of a block of Precambrian and Ordovician rocks onto Pennsylvanian rocks has created an apparent low-angle thrust fault, but stratigraphic as well as structural evidence indicates a gravitational sliding origin for the block.—Authors' abstract

Giardini, A. A. *See* Forbes, Warren C. 5091

5092 **Giardini, A. A.** Internal pressure differences predicted by elastic theory for mineral systems in the form of overlapping shells subjected to high external hydrostatic pressure [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 74, 1966.

5051 **Gietz, Otto.** The Whirlpool Sandstone [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 448, 1965.

Gilbert, Francis P. *See* Henderson, John R. 5233

Glaister, R. P. *See* McCrossan, R. G. 5032

Glaister, R. P. *See* Nelson, S. J. 5346

5312 **Goldsmith, Werner; Austin, Carl F.; Wang, Cheh-Cheng; Finnegan, Stephen.** Stress waves in igneous rocks: Jour. Geophys. Research, v. 71, no. 8, p. 2055–2078, illus., tables, 1966.

The transmission and decay of stress waves have been studied in bars of igneous rocks, including a coarse-grained leucogranite, a fine-grained spessartite, and a fine-grained to aphanitic basalt. Ballistically suspended bars of these materials were impacted longitudinally by steel spheres, and the shape and velocity of propagation of the resultant shock wave were measured with strain gages. Similar experiments on an aluminum alloy bar established the magnitude of geometrical dispersion. Static tests on fresh and shocked rods agreed with predicted effects of stress wave passage on the rock structure, including the formation of oriented fractures and a general lowering of the static Young's modulus.—D.B.V.

5316 **Goodfield, Alan Granger.** Pleistocene and surficial geology of the city of St. Louis and the adjacent St. Louis County, Missouri [abs.]: Dissert. Abs., v. 26, no. 9, p. 5368, 1966.

5392 **Graf, Donald L.; Friedman, Irving; Meents, Wayne F.** The origin of saline formation waters—[Pt.] 2, Isotopic fractionation by shale micropore systems: Illinois Geol. Survey Circ. 393, 32 p., illus., tables, 1965.

The concentrations of deuterium and O-18 are given for 95 formation waters from the Illinois, the Michigan, and the Alberta Basins, and the Gulf Coast. A small isotopic fractionation resulting from passage of water through micropores in shales is postulated as explanation for the regularity remaining between the two isotopic parameters after both have been normalized. This postulate generates predicted directions of fluid movement, between pairs of nearby samples, that are in reasonable agreement with the limited hydrologic information available. Several samples with unusually high deuterium content, from two areas of restricted groundwater recharge, may result from flow rates small enough to permit significant diffusional mixing behind shale barriers.—*from* Authors' abstract

5375 **Graham, E. C.** (editor). The basic dictionary of science: New York, Macmillan Co., 568 p., illus., tables, 1966.

The dictionary gives the meanings of more than 25,000 words and word groups taken from physics, chemistry, biology, medicine, psychology, astronomy, geology, and anthropology, as well as important fields of science in industry, in Basic English. The general level of selection is about that of first-year university work.—E.S.L.

5100 **Grant, Willard H.** A comparison of red residual clays from the tropic and subtropics [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 76, 1966.

Gravenor, C. P. *See* Barton, Robert H. 5021

5016 **Grayston, L. D.; Sherwin, D. F.; Allan, J. F.** Middle Devonian, Chap. 5 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 49–59, illus., 1966.

The Elk Point Group, mainly of Middle Devonian age, forms the base of the Devonian System in western Canada. It comprises a cyclical sequence of evaporite, carbonate and clastic rocks up to 2,000 feet thick in the Plains, and over 3,500 feet thick in the Rocky Mountains. Reef carbonates are well developed in the upper half of the section. The Lower Elk Point, in the Plains area, was laid down in three distinct basins that slowly expanded and eventually merged to give a single enlarged basin at the beginning of Upper Elk Point deposition. This latter basin extended from North Dakota to the Northwest Territories. The entire Elk Point interval in the Rocky Mountains was probably deposited in a single basin, the Cordilleran basin.—Authors' abstract

Grayston, L. D. *See* Belyea, Helen R. 5343

Green, P. E., Jr. *See* Frosch, R. A. 5262

5355 **Gresens, Randall L.** The effect of structurally produced pressure gradients on diffusion in rocks: Jour. Geology, v. 74, no. 3, p. 307–321, illus., 1966.

A thermodynamic model for diffusion along grain boundaries induced by a pressure gradient is presented, assuming that the dispersed (intergranular) phase may be treated as a separate phase, and that the dispersed phase can support a pressure gradient. With solid phases constant in composition, diffusion in the dispersed phase takes place in response to gradients of chemical potential within that phase, and leads to compositional gradients parallel to pressure gradients. Two possibilities are arrived at: 1) concentration and nucleation of some components in preferred sites, and 2) systematic compositional variations in a given mineral related to the structure.—*from* Author's abstract

Grey, F. F. *See* Belyea, Helen R. 5343

Grey, H. *See* McCrossan, R. G. 5032

Grey, Howard J. *See* Stanley, Kirk W. 5007

5158 **Griffith, J. W.; Roscoe, S. M.** Canadian resources of uranium and thorium [with French, Russian, and Spanish abs.], *in* Internat. Conf. Peaceful Uses Atomic Energy, 3d, Geneva, 1964, Proc., V. 12, Nuclear fuels—[Pt.] 3, Raw materials: New York, United Nations, p. 34–41, illus., tables, 1965.

One of the largest known uranium deposits of the world is in Canada, where present reserves represent about 37 percent of the total among published statistics. Production from 25 mines in 1958 was reduced to 7 in 1963 with the decline in markets. There is growing concern about long-term supplies for an increasing demand in nuclear power. Gradually reduced operating costs are placing larger amounts of uranium in lower-price categories, with thorium as a by-product. Elliot Lake deposits and future sources are described briefly, and estimates of reserves are summarized. The reserves are almost entirely in conglomerates; but with increased prices reserves and production from pegmatites would increase rapidly.—G.D.C.

5054 **Griffiths, R. E.** The geology of the Wynd map-area, Jasper, Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 451, 1965.

5236 **Griggs, Allan B.** Reconnaissance geologic map of the west half of the Spokane quadrangle, Washington and Idaho: U.S. Geol. Survey Misc. Geol. Inv. Map I-464, scale 1:125,000, 1966.

Griggs, D. T. *See* Christie, J. M. 5009

5278 **Grunevald, Henri.** Geologie de la Martinique—Memoires pour servir à l'explication de la carte geologique detaillee de la France: Paris, Ministère de l'Industrie, Departement de la Martinique, 144 p., illus., tables, geol. maps, 1965.

The eleven chapters of this memoir explain the physical geography, early geologic descriptions, and volcanic structure of Mont Pelee and other types of active and inactive features of the island of Martinique; also its petrography, principal outcrops, fossils, Cenozoic stratigraphy, chronology, chemical alteration and soils, limited mineral resources, volcanism and tectonics; and the arcuate structure of the Antilles. The appendix gives a resume of new results from this survey; the resulting schematic geologic map, on a scale of 1 to 1,000,000 is in pocket. Tables of chemical analyses are given in the text.—G.D.C.

5134 **Guber, Albert L.; Jaanusson, Valdar.** Ordovician ostracodes with posterior domiciliar dimorphism: Uppsala Univ. Geol. Inst. Bull., v. 43, no. 1, 43 p., illus., 1965.

Kloedenellid domiciliar dimorphism is definitely recognized in the new Ordovician family Monotiopleuridae, believed to be the earliest true Kloedenellacea, which includes *Monotiopleura* n. gen. and *Primitiella* Ulrich, 1897. Another new Ordovician family, Lomatopisthiidae, superfamily uncertain, is characterized by a special type of posterior domiciliar dimorphism; it includes four new genera, *Lomatopisthia, Dibolbopisthia, Bolbopisthia, and Physalidopisthia*. Seven species are described, all from North America, including the new species *Monotiopleura auriculata and Dibolbopisthia arbucklensis*; the Lomatopisthiidae are restricted to North America. Synonymies include species of *Primitia, Beyrichia, Leperditella, and Thomasatia*. Carapace terminology and morphology are discussed.—V.M.J.

Guidotti, Charles V. *See* Evans, Bernard W. 5367

5407 **Guinn, V. P.** Advances in neutron activation analysis [with French, Russian, and Spanish abs.], *in* Internat. Conf. Peaceful Uses Atomic Energy, 3d, Geneva, 1964, Proc., V. 15, Special aspects of nuclear energy and isotope applications: New York, United Nations, p. 433–444, 1965.

In the rapid advance of neutron activation analysis in the United States, during the past six years, new and better equipment and techniques have increased its capabilities and areas of useful application. The widespread use of the small neutron

generator enables the method to compete with others in minor- and major-element analyses, whereas it had been restricted to trace determinations only. In the trace-level field, advanced methods use high-flux reactors with special provisions for efficient neutron-activation analysis, high-intensity reactor pulses, and effective utilization of reactor fast neutrons. The principal areas of improvement in equipment, techniques, and applications in the physical sciences and industry are discussed.—G.D.C.

5207 **Gunn, Donald William.** Late Devonian regional unconformity in and around the Uinta Mountains, Utah [abs.]: Dissert. Abs., v. 26, no. 9, p. 5368, 1966.

5356 **Habashi, Fathi.** Radioactivity in phosphate rock: Econ. Geology, v. 61, no. 2, p. 402–405, illus., table, 1966.

Uranium content of sedimentary phosphates from different localities is proportional to total gamma activity, indicating that uranium is in radioactive equilibrium with its decay products.—W.S.W.

5249 **Halbouty, Michel T.** Economics—The new dimension in geologic thinking [abs.]: Mtn. Geologist, v. 3, no. 2, p. 93, 1966.

5333 **Hale, L. A.; VandeGraaff, Fred.** Correlations of Cretaceous formations in adjoining areas of Wyoming, Utah, and Colorado, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 8–9, chart, 1965.

This correlation chart covers Coalville, Red Creek, and Castle Valley in the Wasatch Plateau, Utah; Kemmerer region, Rock Springs uplift, and Rawlins-Deep Creek area, Wyoming; and Rangely-Douglas Creek arch, Axial basin, and Vermilion Creek, Colorado. Faunal zones are included.—E.S.L.

5108 **Hales, A. L.; Helsley, C. E.; Dowling, J. J.; Nation, J. B.** Some logistics of the east coast on-shore off-shore experiment (ECOOE): Earthquake Notes, v. 37, no. 1, p. 25–32, illus., 1966.

A large scale seismic crustal structure experiment was conducted off the east coast of the United States in 1965. Seismic waves were recorded from two large shot profiles normal to the continental shelf with nearly orthogonal components, the northern profile just south of the Maryland-Virginia border and the southern crossing the coast near Camp Lejeune, North Carolina. A second southern profile was shot parallel to the edge of the shelf about 20 to 30 km from the coast. Underwater shots (20 lb-10 tons in size) were fired on the ocean bottom where the water was less than 600 feet deep; in deep water, shots greater than one ton were floated about 300 feet before detonation. Some of the difficulties in determining accurate shot positions are discussed. The various institutions involved in the program are indicated.—V.S.N.

Hallbick, D. C. *See* Gardiner, M. J. 5005

5231 **Halliday, William R.** Depths of the earth—Caves and cavers of the United States: New York, Harper and Row, Publishers, 398 p., illus., 1966.

Twenty-six chapters give popular accounts of individual well-known caves or States containing caves, and their exploration.—E.S.L.

5164 **Hamblin, W. K.** Rhythmic laminations within some seemingly homogeneous sandstones of Kansas and Oklahoma, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 183–189, illus., 1964 [1966].

A radiographic analysis of 123 samples of Pennsylvanian sandstones from Kansas and Oklahoma reveals that the internal structure of these rocks consists of regular rhythmic alternations of "dense" and "light" layers. In many respects the laminations resemble varves, but the individual layers are characteristically undulatory and lenticular and have gradational contacts. The expression of the

laminations on a radiograph results from density variations presumably caused by concentrations of accessory minerals and iron oxide cement. Although it is possible that these laminations are annual, or represent some other period of time, they probably result from influx layers which accumulated under a given current velocity and direction without a definite cycle of time involved in the sedimentary process.—*from* Author's abstract

5165 **Haney, Warren D.; Briggs, Louis I.** Cyclicity of textures in evaporite rocks of the Lucas Formation, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 191–197, illus., tables, 1964 [1966].

Evaporites are characterized in a vertical sequence by cycles of rock types, such as dolomite–anhydrite–halite–anhydrite–dolomite. Associated with the rock sequences are textures, peculiar to certain rock types, which also occur in cyclic sequences. In the Devonian Lucas Formation of Michigan the textures associated with anhydrite rocks are decussate anhydrite, nodular anhydrite, reticulated anhydrite, and massive anhydrite. The textures can be related in a general way to physicochemical conditions of mineral precipitation; thus, they are clues to changing conditions of evaporite deposition.—Authors' abstract

5166 **Harbaugh, John W.** Significance of marine banks in southeastern Kansas in interpreting cyclic Pennsylvanian sediments, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 199–203, illus., 1964 [1966].

Marine banks are known to occur in seven stratigraphic units in the Pennsylvanian Lansing and Kansas City Groups. They are interpreted as being mounds of loose carbonate material, and may be considered as offshore bars; some are stacked one upon another. It appears that the open sea, the banks, and broad depositional apron remained in about the same locations during this time. Thus, large-scale transgressions and regressions may not be as essential for Pennsylvanian–Permian cyclic sediments as previously supposed.—E.S.L.

5337 **Harms, J. C.; MacKenzie, D. B.; McCubbin, D. G.** Depositional environment of the Fox Hills sandstones near Rock Springs, Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 113–139, illus., 1965.

The Fox Hills Sandstone was evidently deposited in littoral or shallow marine environments, but no evidence is found that the sandstones formed barrier islands. Some features of these sandstones, such as the widespread erosion surfaces in the lower part, are not yet known in modern barrier island sequences. The question of origin of the Fox Hills Sandstone is of vital importance to exploration geologists because these transitions may hold untapped oil fields. Although additional data is presented and interpretations evaluated, no alternative depositional analog is offered.—E.S.L.

Hart, S. R. *See* Wetherill, G. W. 5364

5208 **Hatfield, Craig Bond.** Stratigraphy and paleoecology of the Saluda Formation (Upper Ordovician) in Indiana, Ohio and Kentucky [abs.]: Dissert. Abs., v. 26, no. 9, p. 5368–5369, 1966.

5391 **Hawaii Div. Water and Land Devel.** Water resources development—Molokai: Hawaii Div. Water and Land Devel. Bull. B16, 69 p., illus., tables, 1966.

Molokai was formed by volcanic activity which probably started during Tertiary and continued into Pleistocene, accompanied by periods of emergence and submergence of the island mass. Erosion of the volcanic domes and deposits of sediment contributed to the topography. Ground-water resources are of three types: basal, which underlies most of the island, and ranges from good quality in East Molokai, to entirely brackish in West Molokai; perched, often of such volume that some of it runs underground along ash beds and issues as springs which are sometimes included in county water systems; and dike-confined, developed with tunnels or wells from accumulations to levels at which leakage equals recharge.

Salt water intrusion can be minimized by control of draft from ground-water sources. Plans for future development are outlined.—M.C.M.

5365 **Hawkins, Richard H.** (and others). North Coastal area investigation (preliminary edition)—App. A, Watershed management in the Eel River Basin: California Dept. Water Resources Bull. 136, App. A, 141 p., illus., tables, geol. map, 1964.

The Eel River basin is a complex system of northwest trending ridges and valleys with trellis drainage controlled by faults or crushed zones in the underlying thick folded rocks. Most rocks are sediments of the Franciscan Formation of Jurassic-Cretaceous age, with a few Cretaceous and Tertiary pockets. Landsliding is widespread on unstable deeply weathered slopes on soil derived from the Franciscan Formation. The complex geologic history of the area is reviewed; recent uplifts are the cause of deeply incised canyons. There are few important aquifers, except in four alluvial valleys formed by down faulted blocks. A modified map of the general geology is shown. It is possible that minor earth movements in the soil zone could be retarded by proper watershed management techniques.—G.D.C.

5344 **Hawley, C. C.; Wyant, D. G.; Brooks, D. B.** Geology and uranium deposits of the Temple Mountain district, Emery County, Utah: U.S. Geol. Survey Bull. 1192, 154 p., illus., tables, geol. map, 1965.

The district is on the southeast flank of the asymmetric domal San Rafael Swell, and is underlain by sedimentary rocks ranging from Permian to Jurassic age. Uranium vanadium deposits occur mostly in the Moss Back Member of the Late Triassic Chinle Formation; near pipe-like collapse structures containing altered and broken sedimentary rock deposits are found in other rock units and in the collapses themselves. Ore is composed of uraniferous asphaltite with subordinate pyrite, montroseite, sphalerite, uraninite, ferroselite and other metallic minerals. The asphaltite formed by reaction of introduced aqueous solutions with petroleum contained in the rocks. Uranium, selenium, and arsenic probably had their source far from the deposits; vanadium and chromium may have been partly derived locally.—C.C.H.

5394 **Heirtzler, J. R.; Burckle, Lloyd H.; Peter, George.** Magnetic anomalies in the Gulf of Mexico: Jour. Geophys. Research, v. 71, no. 2, p. 519-526, illus., 1966.

A preliminary magnetic map of the Gulf of Mexico is presented in three parts. An elongated magnetic low centered south of Galveston dominates the area between the Texas-Louisiana coast and the Sigsbee scarp. Campeche bank displays N-S and NE-SW trending anomalies extending across the bank and north of the Campeche escarpment. Numerous local anomalies occur on the West Florida shelf but the northwest corner of the Gulf has relatively strong anomalies striking NE-SW. Several major magnetic trends on adjacent land masses can be traced into the Gulf. Anomaly trends in the northeastern Gulf parallel the strike of buried Appalachian structures to the north.—D.B.V.

5329 **Hellner, E.; Schürmann, K.** Stability of metamorphic amphiboles—The tremolite-ferroactinolite series: Jour. Geology, v. 74, no. 3, p. 322-331, illus., tables, 1966.

The stability of the mix-crystal series was investigated hydrothermally (P_{water} 1,000 bars, partial $P_{carbon\ dioxide}$ 50 bars) between 250° and 650°C in a strongly reducing atmosphere. Complete solid solubility extends from pure tremolite to pure ferroactinolite between 500° and 570°-650°. The lowest stability point of actinolite is a pseudo-eutectic at $Mg_{25}Fe_{75}$ (mole percent end members). Below 375°, mixtures in the range Fe_0-Fe_{70} yield talc, calcite, and quartz; at about Fe_{70} olivine appears as an additional phase; at Fe_{90} talc disappears, leaving olivine, calcite, and quartz. At high Mg concentrations, talc and diopside are a stable assemblage between 430° and 500°. The phases are diagrammed and compared with natural assemblages. Some X-ray powder data obtained at 550° are given for five members of the series.—B.F.L.

Helsley, C. E. *See* Hales, A. L. 5108

Henderson, James H. *See* Preston, Floyd W. 5176

5233 **Henderson, John R.; Gilbert, Francis P.** Aeromagnetic map of the Mount Pleasant, Albemarle, Denton, and Salisbury quadrangles, west-central North Carolina: U.S. Geol. Survey Geophys. Inv. Map GP-581, scale 1:62,500, 1966.

Henry, Vernon J., Jr. *See* Hoyt, John H. 5084

5413 **Herbert, C. F.; Race, W. H.** Geochemical investigations of selected areas in southeastern Alaska, 1964 and 1965: Alaska Div. Mines and Minerals Geochem. Rept. 6, 66 p., illus., tables, 1965.

Southeastern Alaska, comprising about seven percent of the area of the State, has produced about 17 percent of its metals. Although the area is widely mineralized, few parts have been prospected. Geochemical testing of stream sediments with available geologic information should prove useful to prospectors. Of the 12 areas investigated, five are recommended for further prospecting: Skagway; William Henry Bay; and Mansfield Peninsula, Gambier Bay, and Pybus Bay on Admiralty Island. For each of the 12 areas, the geology, previous work, geochemical investigation and prospecting are summarized; analyses are tabulated; samples are shown on sketch maps.—M.C.M.

5035 **Herreid, Gordon; Rose, Arthur W.** Geology and geochemistry of the Hollis and Twelvemile Creek areas, Prince of Wales Island, southeastern Alaska: Alaska Div. Mines and Minerals Geol. Rept. 17, 32 p., illus., tables, geol. map, 1966.

The central part of the Hollis map area is underlain by a sequence of graywacke, conglomeratic graywacke, banded siltstone-argillite, and black slate about 10,000 feet thick, overlain by about 2,000 feet of andesite agglomerate and flows, and more sediments. Bedding in the main part dips 20–50° west and southwest. Known ore deposits consist of quartz and quartz-carbonate veins containing pyrite, chalcopyrite, galena, sphalerite, gold, and silver, and are of value chiefly for their gold content. About half the stream sediment samples are anomalous in zinc, and a smaller proportion in copper, lead, and molybdenum. In the Twelvemile Creek area pre-Devonian greenstone, schist, metagraywacke, black phyllite, and marble of the Wales group and Devonian(?) sediments and volcanics are exposed. Nine stream sediment samples are weakly to moderately anomalous in zinc, copper, lead, and/or molybdenum.—*from* Authors' abstract

Hersey, J. B. *See* Bowin, C. O. 5306

5267 **Hess, H. H.; Revelle, Roger.** The origins of the continents, oceans, and atmosphere, *in* The scientific endeavor—Centennial celebration of the National Academy of Sciences (1963): New York, Rockefeller Inst. Press, p. 108–112, 1965.

Facts and surmises concerning the early history of the Earth are summarized. Of an estimated 1/500th of the initial mass of matter from which the Earth was formed, over two thirds is in the mantle, about 0.4 percent in the crust; the oldest rocks, less than 3 b.y. old, are half as old as the Earth itself and are progressively younger toward continental margins. No rocks over 100 m.y. old have been found in ocean basins where central ridges, a few tens of millions of years old are marked along their axes by rift valleys or rifts recently filled with lava. Radioactive heat from potassium decay deep within the mantle may produce great convective currents slowly turning over mantle rocks. Recent paleomagnetic evidence gives impetus to the continental drift hypothesis. Free oxygen, absent in the early atmosphere, accumulated when plants developed photosynthesis and animals were buried in marine sediments.—G.D.C.

5298 **Heylmun, Edgar B.** Geothermal power potential in Utah: Utah Geol. and Mineralog. Survey Spec. Studies 14, 28 p., illus., tables, 1966.

A brief summary is given of the potential in Utah for development of geothermal energy. Previous work in Utah is listed and mention is made of exploration methods used throughout the world. Thermal spring areas in Utah are grouped into the Wasatch, Western desert, Sevier-Sanpete, Panguitch, Hurricane, and Snake Valley

areas, all roughly parallel or en echelon and trending in north–south or northeast–southwest directions; short descriptions are given of each area including principal warm and hot springs. Oil, gas, and water wells which have penetrated warm or hot water at depth are listed with depth and temperatures recorded; temperatures are given also for a few mines. Available chemical analyses of hot spring waters are included. The Wasatch and Western desert areas are the most extensive but the latter offers the greater possibility for development of steam wells.—V.S.N.

Higgins, G. H. *See* Johnson, G. W. 5408

5421 **Hills, Francis Allan.** The Precambrian geology of the Glenns Falls and Fort Ann quadrangles, southeastern Adirondack Mountains, New York [with] section 2—Illustrations [abs.]: Dissert. Abs., v. 26, no. 9, p. 5369, 1966.

5022 **Hitchon, Brian.** Formation fluids, Chap. 15 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 201–217, illus., tables, 1966.

From 20,000 analyses of crude oils, natural gases, formation waters and their associated drillstem-test charts from the western Canada sedimentary basin, systematic regional variations in physical and chemical properties are evaluated. There are both areal variations within each stratigraphic unit and vertical trends from one to another unit. Correlation curves illustrated for major crude oils suggest that those from the Mannsville Group (asphaltic, with high sulfur) reflect Lower Cretaceous depositional environments different from all others of paraffin type. Comparison is made also with respect to nitrogen, carbon dioxide and hydrogen sulfide in natural gases and chloride and sodium content in various Paleozoic formation waters. Post-depositional effects are considered. Illustrations include maps showing regional variations, and composition diagrams.—G.D.C.

5296 **Hlavin, W. J.** A preliminary note on some significant fossil finds from the Interstate Route 71 paleontological salvage operation: Soc. Vertebrate Paleontology News Bull. 76, p. 49–50, 1966.

During 1955 more than 2,000 specimens of fishes, mainly arthrodires, elasmobranchs, and ganoid actinopterygians, were collected by the Natural Science Museum from highway excavations in the Upper Devonian Cleveland Shale in Cleveland, Ohio. In one outstanding specimen of the arthrodire *Titanichthys*, soft body tissue associated with head and shoulder bones is preserved. Lower jaws and plates of nine new genera of a hitherto unknown group of arthrodires have been found. More highly fossiliferous areas should be reached in 1966.—V.M.J.

5261 **Holzer, F.** Calculation of seismic source mechanisms: Royal Soc. [London] Proc., ser. A, v. 290, no. 1422, p. 408–429, illus., table, 1966.

A method is described which allows computation, in the inelastic region and near the inelastic-elastic boundary, of earth motions resulting from an underground nuclear detonation. It uses a one-dimensional digital computer code in which the conservation equations are transformed to difference equations in Lagrangian form. Experimental confirmation of the method is most convincing in the region above 10 kb; in the lower stress region the calculation is more difficult and not quite as successful. A two-dimensional computer code also has been devised and is about to become operational; it will be able to handle two-dimensional sources as well as surface wave propagation problems.—D.B.V.

5415 **Hopkins, D. M.; Einarsson, Thorleifur.** Pleistocene glaciation on St. George, Pribilof Islands: Science, v. 152, no. 3720, p. 343–345, illus., 1966.

A small ice cap (covering about 12 sq km) and at least two—probably four—cirque glaciers (each covering less than 1 sq km) occurred on St. George Island, Pribilof Islands, probably during the Illinoian Glaciation. Snowbanks persisted during a later cold cycle, probably during the Wisconsin Glaciation, with no glaciers existing. We found no evidence of glaciation on other Pribilof Islands.—Authors' abstract

Hopkins, George, Jr. *See* Word, Darrell R. 5012

Hopson, C. A. *See* Wetherill, G. W. 5364

5084 **Hoyt, John H.; Henry, Vernon J., Jr.** Significance of inlet sedimentation in the recognition of ancient barrier islands, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 190–194, illus., 1965.

The Georgia barrier island system, especially the inlets and longshore current, is described as an aid in recognition of ancient barrier systems and shorelines. A barrier island inlet model is proposed based on observed conditions of the Georgia coast. Profiles and sections are included.—E.S.L.

5086 **Hoyt, John H.; Weimer, Robert J.** The origin and significance of *Ophiomorpha (Halemenites)* in the Cretaceous of the Western Interior, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 203–207, illus., 1965.

Comparison of the burrows of *Callianassa major* and fossil *Ophiomorpha* suggests a common origin. When used in conjunction with other criteria, *Ophiomorpha* may be used successfully to trace ancient shorelines and to determine former sea level positions. It has been useful in Cretaceous environmental studies in the Rocky Mountain area as an indicator of shallow marine sedimentation.—E.S.L.

5264 **Hudson, J. A.; Knopoff, Leon.** The nature of seismic noise: Royal Soc. [London] Proc., ser. A, v. 290, no. 1422, p. 290–296, table, 1966.

The main problem treated here is that of the scattering of body waves of P and S type in an unbounded homogeneous medium. Magnitudes of scattered PP, PS, SP, and SS are computed; phase shifts in incident P and S can also be computed. Both P and S type body waves convert more easily into scattered S waves than into scattered P; thus P waves show small phase shifts and S waves, large. The approximations in the calculations are those for Rayleigh scattering; hence the scattering varies as the 4th power of the frequency, and the mean square scattered energy is proportional to the linear dimension of the scattering region.—D.B.V.

Hunt, G. H. *See* Burwash, R. A. 5010

5046 **Hurst, Donald Lindsay.** The glacial and Pleistocene geology of the Dundas Valley, Hamilton, Ontario [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 449, 1965.

Hurst, Vernon J. *See* Salotti, Charles A. 5000

5097 **Husted, John E.; Kaarsberg, E. A.; Straley, H. W., 3d.** Report on East Coast seismic experiment of 1965 [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 76, 1966.

Husted, John E. *See* Dorman, LeRoy M. 5098

5167 **Imbrie, John; Laporte, Léo F.; Merriam, Daniel F.** Beattie Limestone facies (Lower Permian) of the northern Midcontinent, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 219–238, illus., 1964 [1966].

Ten distinct facies, recognized in the Beattie and described briefly, are not adequately explained by a simple transgression–regression hypothesis; other factors to be considered are mainly hydrographic, water turbulence and circulation, and rate of terrigenous influx. Many facies originated close to sea level. A stratigraphic framework is provided by a series of eight market beds with overlapping ranges. An isopach map of the Florena Shale is included, and ten measured sections are given in an appendix.—E.S.L.

Imbrie, John. *See* Laporte, Léo F. 5169

Jaanusson, Valdar. *See* Guber, Albert L. 5134

5118 **Jacka, Alonzo D.** Depositional dynamics of the Almond Formation, Rock Springs uplift, Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 81–100, illus., 1965.

In the Rock Springs uplift, the Cretaceous Almond Formation consists of a lower alluvial unit and an upper transitional and marine unit displaying a sequence of four cyclic deposits. These cycles reflect shifting of three contemporaneously existing entities: marine, barrier-island, and lagoonal-bay environments. Sedimentary structures in the barrier-island sandstones are described and illustrated.—E.S.L.

5112 **Jahns, Richard H.** Surficial geologic map of the Greenfield quadrangle, Franklin County, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-474, scale 1:24,000, separate text, 1966.

Paleozoic schist and gneiss form the highlands in the southeastern part of the Greenfield quadrangle; the remainder of the area is underlain by Tertiary medium- to coarse-grained sedimentary rocks and diabase. Unconsolidated glacial and postglacial deposits mask most of the bedrock in valley areas. Drumlins constitute the thickest deposits of till. Deglaciation features comprise eskers, crevasse fillings, kame and outwash deposits. Melt-water deposits associated with proglacial Lake Hitchcock represent the youngest outwash sequence. Windblown silt and fine sand form a discontinuous but widespread blanket, about five feet in maximum thickness, over bedrock and glacial deposits. Swamp deposits are present in nearly all parts of the quadrangle.—M.C.M.

5308 **James, David E.** Geology and rock magnetism of Cinder Cone lava flows, Lassen Volcanic National Park, California: Geol. Soc. America Bull., v. 77, no. 3, p. 303–312, illus., table, 1966.

At least four Recent quartz basalt flows are associated with Cinder Cone and are petrographically indistinguishable. Quartz xenocrysts, siliceous pumice inclusions, and a high (56 percent) silica content in the presence of 6–8 percent olivine indicate contamination of basalt. Large scatter in magnetic directions of flow surface and volcanic bomb samples indicates rotation of surface lava blocks after cooling below the Curie point.—A.G.

Jansonius, Jan. *See* Staplin, Frank L. 5362

Jobert, Georges. *See* Blum, P. A. 5424

Jobert, Nelly. *See* Blum, P. A. 5424

Johns, W. M. *See* Sahinen, U. M. 5395

5408 **Johnson, G. W.; Higgins, G. H.** Engineering applications of nuclear explosives—Project PLOWSHARE [with French, Russian, and Spanish abs.], *in* Internat. Conf. Peaceful Uses Atomic Energy, 3d, Geneva, 1964, Proc., V. 15, Special aspects of nuclear energy and isotope applications: New York, United Nations, p. 356–368, illus., tables, 1965.

Results of the PLOWSHARE program offer increasing promise of success for use of nuclear explosives in excavations for transportation constructions, petroleum and mining technology, research purposes, and possible release of oil from tar sand. In some cases of deep underground contained explosions the surface remains relatively undisturbed, but marked subsidence can occur with delayed collapse of the cavity. Data from thirteen detonations in different rock media are compared. Most of the shallow cratering excavation has been done in desert alluvium, but limited cratering has also been done in basalt and tuff. Safety problems are subject to control involving selection of minimum yield for each detonation, temporary

population evacuation, appropriate meteorology, and monitoring after the explosion.—G.D.C.

Johnson, Helgi. *See* Williams, M. Y. 5064

5352 **Jopling, Alan V.** Some principles and techniques used in reconstructing the hydraulic parameters of a paleo flow regime: Jour. Sed. Petrology, v. 36, no. 1, p. 5–49, illus., 1966.

Some principles of sediment transport mechanics and interpretational techniques were applied to study of a composite set of crossbedding in a Pleistocene (Wisconsin) fluvioglacial sand at Littleton, Mass. Current strength of the paleo flow stream regime was estimated from median grain size. Sorting and dispersion of sizes within the deposit were used to estimate flow conditions associated with formation of bedding structures. Dune forms were used to estimate stream depth. Estimates of velocity and depth of stream flow were found to be essential to interpretation and formed the basis for extrapolation of many other parameters meaningful to environmental reconstruction and quantitative studies of sediment transport.—R.A.C.

Judoley, Constantino M. *See* Furrazola Bermudez, Gustavo. 5338

5105 **Just, Evan.** Mineral supplies for a teeming world, *in* Minerals Day collected papers: Skokie, Ill., Internat. Minerals and Chem. Corp., Mining and Explor. Div., p. 2–13, 1965.

Given enough energy, a progressive civilization can be maintained on the minerals of the common rocks and the ocean. The most abundant elements occur in the upper part of the crust in such amounts that, no matter what we do with them, they will turn up somewhere in reclaimable form. Even of the less abundant materials, there may never be an end to supplies, with continued ingenuity and technical progress. Growing population and urbanization bring problems to the mineral industry, especially in competition for land and need for specialized exploration. The problems of mineral supply will be solved by a combination of five factors: technical progress in utilization, better methods of exploration, conservation, higher prices, and substitution.—G.D.C.

Kaarsberg, E. A. *See* Husted, John E. 5097

5093 **Kaarsberg, Ernest A.** Magnetic survey of the epicentral area of the Puget Sound Earthquake of April 29, 1965 [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 74, 1966.

4988 **Kane, W. T.; Slaughter, M.** The crystal structure of the zeolite epistilbite, $Ca_4Al_8Si_{18}O_{48}{\cdot}15H_2O$ [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 264, 1966.

Keester, Kenneth L. *See* White, William B. 5322

5089 **Keith, Bob.** Geology of the Rock Springs uplift, Sweetwater County, Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., map, scale 1:250,000, 1965.

5126 **Keith, Robert E.** Rock Springs and Blair Formations on and adjacent to the Rock Springs uplift, Sweetwater County, Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 42–53, 1965.

These formations are characterized by abundant littoral marine sandstones, with a combined average of 2,750 feet in thickness. An isometric diagram gives a generalized picture of the relationship of the different stratigraphic units, which are described, and an environmental interpretation is made.—E.S.L.

Kennedy, David N. *See* Baumli, George R. 5318

Kennedy, G. C. *See* Cohen, L. H. 5380

5360 **Kenney, T. C.** Permeability ratio of repeatedly layered soils: Norges Geotek. Inst. Pub. 63, 9 p., illus., reprinted 1965; originally published 1963.

The assumption that the permeability ratio of a repeatedly layered soil deposit is large need not be true for all layered soils. Particular attention is given to the effect of the manner in which permeability coefficients vary across the repeated layers. Horizontal non-conformities in the form of dissimilar soil layers can both increase or decrease the permeability ratio. Laboratory-test data for small samples of Canadian varved sediments (Bazett and Brodie, 1961) indicate low values, of the order of $R_k = 2$, in contrast to field measurements of pore-pressure dissipation rates for a deposit of Boston clay (Gould, 1949) which indicated that R_k was between 34 and 50. In the study of particle size changes, the measurement of R_k for small specimens may be a simple approach.—G.D.C.

Kenny, G. S. *See* Wermund, E. G. 5309

5140 **Kepferle, Roy C.** Geologic map of the Howardstown quadrangle, central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-505, scale 1:24,000, section, text, 1966.

Limestone for road metal, sub-grade, and fill has been quarried in the Howardstown quadrangle. Gas in minor amounts, in or beneath the New Albany Shale, has been encountered in several test holes, but no oil has been recovered. Clay shale from the lower part of the Borden Formation is used for several purposes. Water for domestic and farm use is obtained from alluvial fill, and from wells and springs in the Harrodsburg Limestone, Beechwood Limestone Member, and Laurel Dolomite.—M.C.M.

5057 **Kieller, B. J.** Mineralogy of the No. 2 zone Eldorado mine, Port Radium, Northwest Territories [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 452, 1965.

Kirchner, E. *See* Prewitt, C. T. 4996

Kirkland, Douglas W. *See* Anderson, Roger Y. 5305

5058 **Kirmani, Khalil-Ullah.** The Duhamel reef, Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 451-452, 1965.

5302 **Kistler, R. W.; Dodge, F. C. W.** Potassium-argon ages of coexisting minerals from pyroxene bearing granitic rocks in the Sierra Nevada, California: Jour. Geophys. Research, v. 71, no. 8, p. 2157-2161, tables, 1966.

Potassium-argon dates were determined for pyroxene, plagioclase, orthoclase, biotite, and hornblende from two granitic rocks of different thermal histories. The pyroxenes from both rocks yielded low ages relative to the other mineral phases. The argon deficiency in the pyroxenes suggests that lattice imperfections due to exsolution or to alteration to hornblende may make these minerals from hydrous plutonic environments poor retentive reservoirs for internally produced radiogenic argon.—Authors' abstract

Klein, Edward. *See* Zapanta-LeGeros, Racquel. 5328

Klement, W., Jr. *See* Cohen, L. H. 5380

5028 **Klovan, J. E.** The use of factor analysis in determining depositional environments from grain-size distributions: Jour. Sed. Petrology, v. 36, no. 1, p. 115-125, illus., 1966.

Three kinds of marine shore-line energy environments were identified from the results of factor analysis of the grain-size distributions of 69 samples of sediment collected from Barataria Bay, La., by Krumbein and Aberdeen (1937). The environments are: surf energy dominant, current energy dominant, and gravitational

energy dominant. Factor analysis, as illustrated, offers a more objective method of studying, comparing and interpreting grain-size distributions of sediments than does the correlation of such arbitrary statistical measures as skewness and kurtosis. Input consisted of the weight percent of sediment in each of the same ten size classes for each of the samples.—R.A.C.

5248 **Klugman, M. A.** Resume of the geology of the Laramie Anorthosite mass: Mtn. Geologist, v. 3, no. 2, p. 75–84, illus., 1966.

The Laramie Anorthosite, underlying the southern part of the Laramie Range in southeastern Wyoming, consists of a larger northern body and a southern body (separated by gneisses and schists); several small exposures rest upon the later hypersthene syenite near the contact. All rock types discussed are Precambrian, but Paleozoic and younger rocks border the mass to the east and west and overlie small areas. Anorthositic rocks underlie more than 80 percent of the area. Hypersthene syenite intrudes marginal areas of the anorthosite in the west, northwest, and southeast, and also older gneisses and schists; on the northern margin hornblende syenite has intruded all older rocks. Granite intrudes all older rocks, and in the east, appears to have truncated the anorthosite mass. This domical anorthosite mass is cut by a number of major faults, with dominant trends of NE, NNW, and NW.—*from* Author's abstract

Knopoff, Leon. *See* Hudson, J. A. 5264

4989 **Knowles, Charles R.** A refinement of the structure of lorandite, $TlAsS_2$ [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 264, 1966.

5197 **Kozlowski, Roman.** On the structure and relationships of graptolites: Jour. Paleontology, v. 40, no. 3, p. 489–501, illus., 1966.

The morphology of the colony in the different graptolite orders is variable but their essential characters such as the initial stages of development, the fine structure, and chemical composition of the skeleton are the same in all representatives of the group. A comparison of graptolites with coelenterates indicates that their similarities are only an expression of convergence. The arguments of Bohlin and observations of Decker are considered erroneous. The fine structure of the skeleton, its chemical composition (protein substances), and the manner of zooid budding are the same in graptolites and in pterobranchs demonstrating that the Graptolithina and the Pterobranchia are closely related groups of the phylum Hemichorda.—R.C.D.

4990 **Kracek, F. C.; Ksanda, C. J.; Cabri, L. J.** Phase relations in the silver-tellurium system [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 265, 1966.

Krishna, P. *See* Verma, Ajit Ram. 5229

5168 **Krumbein, W. C.** The cyclothem as a response to sedimentary environment and tectonism, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 239–247, illus., tables, 1964 [1966].

The classical cyclothem, first studied in western Illinois, can be used as a norm for shelf areas of low relief to study cyclothem variants that occur in different tectono-environmental settings. This approach, developed some years ago, is set into a present-day framework of modal cyclothems statistically defined; of detailed environmental maps based on individual cyclothem members; of cyclothem models based on physical and chemical controls in sedimentation; and on basin facies models. These several approaches to cyclothem studies can be arranged into a hierarchy that relates them to the scale of phenomena involved.—Author's abstract

Ksanda, C. J. *See* Kracek, F. C. 4990

Kupsch, W. O. *See* Taylor, R. Spence. 5020

Kupsch, W. O. *See* Barton, Robert H. 5021

5244 **Kurten, Björn.** The Pleistocene Felidae of Florida: Florida State Mus. Bull. Biol. Sci., v. 9, no. 6, p. 215–273, illus., tables, 1965.

Seven species of Felidae have been identified in fauna from Pleistocene deposits in Florida. They may be divided into two age groups, an early fauna dating from the Illinoian or early Sangamon or both, and a late fauna of Wisconsin date. Recently collected specimens are described, their distribution and distinctive characteristics compared, and morphologic statistics tabulated. Plentiful in both faunas is *Felis onca*, its fossil form larger than the living jaguar. *Smilodon* increased in size during the middle and late Pleistocene, and is compared with the late Wisconsin sabertooth of Rancho La Brea.—G.D.C.

5200 **Lane, G. N.; Martin, R. A.** Redescription of *Chaetetes milleporaceus* Milne Edwards and Haime, 1851: Jour. Paleontology, v. 40, no. 3, p. 651–654, illus., 1966.

The tabulate coral *Chaetetes milleporaceus* Milne-Edwards and Haime, 1851, is redescribed and illustrated, based on topotype specimens from Newburg, Indiana.—Authors' abstract

Lane, N. Gary. *See* Larson, Allan R. 5170

Langbein, W. B. *See* Leopold, L. B. 5239

Laporte, Léo F. *See* Imbrie, John. 5167

5169 **Laporte, Léo F.; Imbrie, John.** Phases and facies in the interpretation of cyclic deposits, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 249–263, illus., 1964 [1966].

Cyclic deposits of the northern midcontinent are rarely adequately interpreted by the application of transgressive-regressive phase hypotheses. Lateral facies analyses help in understanding the attributes of these deposits. The phase approach emphasizes the basinal aspects, and the facies approach, the banklike aspects. Shallow-water deposition on the Great Bahama Banks is discussed along with Pennsylvanian-Permian cyclothems in the northern midcontinent. Environmental maps are included.—E.S.L.

5170 **Larson, Allan R.; Lane, N. Gary.** Repetitive bedding in Triassic sediments in Clark County, Nevada, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 265–274, illus., 1964 [1966].

Marine Triassic sediments in the western Spring Mts. exhibit repetition of a distinctive sequence of lithologies consisting of four units: massive limestone, calcareous shale and mudstone, limestone with disturbed stratification, and calcareous shale and mudstone. Columnar and measured sections are included.—E.S.L.

5082 **Lawrence, John C.** Wasatch and Green River Formations of the southwestern part of the Green River Basin, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 181–187, illus., 1965.

The Chappo and La Barge Members and the New Fork and upper tongues of the Wasatch Formation, and Fontenelle, middle, and upper tongues of the Green River Formation are present in the Cumberland Gap area. The New Fork and upper tongue of the Wasatch Formation are deltaic formed deposits formed in response to tectonic activity. Their relative stratigraphic position shows that the first significant uplift was in the Wind River Mts., and was followed by uplift in the Uinta Mts.—E.S.L.

Lawson, D. C. *See* Sahinen, U. M. 5395

5101 **Lefebvre, Richard H.** Jointing variations in the flows and interbeds of the Columbia River basalts [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 77, 1966.

LeGeros, John P. *See* Zapanta-LeGeros, Racquel. 5328

5239 **Leopold, L. B.; Langbein, W. B.** River meanders: Sci. American, v. 214, no. 6, p. 60–70, illus., 1966.

This is a semi-popular article on the geometry and theory of river meanders showing that a meander approximates a sine-generated curve. This curve has the least variation of change of direction of any familiar geometric curve, and it is the curve of minimum total work of bending. Hence the shape of meanders is the most probable form a river can take.—D.W.R.

5286 **Lepp, Henry.** Chemical composition of the Biwabik Iron Formation, Minnesota: Econ. Geology, v. 61, no. 2, p. 243–250, tables, 1966.

Mean composition of Biwabik, weighted for area and thickness of individual units, shows more Fe and CaO, less SiO_2, than older estimates. Uniformity in composition of composite samples used for calculation is considered to indicate uniformity of chemical and physical environment in source and depositional areas.—W.S.W.

5259 **Leroy, L. W.** The geologist in construction: Mtn. Geologist, v. 3, no. 2, p. 85–88, table, 1966.

Geologists participating in constructional programs assist the civil engineer and designer by evaluating characteristics of rocks upon and in which structures are to be built. Three dimensional geologic data should be as quantitative as possible and presented to the engineering staff in understandable and concise form. A geologist should be cognizant of the many interrelated phases of construction and recognize where he best can contribute to the total planning of a project. He must accept a failure as readily as a success in the event geological evaluation was the basis for the failure.—Author's abstract

5303 **Lewis, H. W.; Treiman, S. B.** Seismic signals from nuclear explosions in overdriven cavities: Jour. Geophys. Research, v. 71, no. 8, p. 2029–2035, illus., 1966.

A static treatment is given of the seismic signal from nuclear explosions in overdriven cavities, with particular attention to the role of the yield condition for the material of the cavity environment and to the role of incipient tension. When the elastic limits are exceeded, the seismic signal is larger than a purely elastic treatment would imply. This enhancement, however, grows relatively slowly with overdrive under certain conditions.—Authors' abstract

5331 **Lewis, J. L.** Measured surface sections of the Almond Formation on the east flank of the Rock Springs uplift, Sweetwater County, Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 101–111, illus., 1965.

Detailed descriptions of Almond lithology are given in six measured sections, 555 to 670 feet in length. No fossils were collected.—E.S.L.

Lewis, Thomas L. *See* Sutton, Robert G. 5029

Lineback, Jerry A. *See* Brown, George D., Jr. 5406

5209 **Link, Peter Karl.** Stratigraphy, of the Mount White-eastern Little Atlin Lake area, Yukon Territory, Canada [abs.]: Dissert. Abs., v. 26, no. 9, p. 5369–5370, 1966.

Lippert, R. H. *See* Merriam, Daniel F. 5006

5410 **Lister, Gordon F.** The composition and origin of selected iron-titanium deposits: Econ. Geology, v. 61, no. 2, p. 275–310, illus., 1966.

Deposits are believed to result from variations in three igneous processes: accumulations of a Fe–Ti rich liquid; injection of a Fe–Ti rich liquid; injection of a Fe–Ti rich mafic pegmatite. Fe–Ti rich liquids were probably generated by filter pressing or liquid immiscibility. Trace elements, particularly the amounts of Cr and V in magnetite and Mn in ilmenite, suggest stage of differentiation of liquids that formed deposits. Fe–Ti ratios of coexisting magnetite and ilmenite may be used to distinguish high–temperature from low–temperature deposits.—W.S.W.

5301 **Lomnitz, C.** Comments on paper by Leon E. Borgman, "Upper bounds for damage due to geophysical hazards" [1965]: Jour. Geophys. Research, v. 71, no. 8, p. 2182, 1966.

The advantage of Borgman's (ibid., v. 70, p. 5313–5321, 1965) proposed statistical model of geophysical hazards is considered doubtful. Statistical methods for estimating the probability of occurrence of geophysical extremes have been available for some time. Their usefulness depends considerably on the amount of extrapolation involved. In the case of earthquake risk, Borgman's first assumption, that the regime of hazardous events naturally repeats itself in a time cycle of c time units, is clearly invalid.—D.B.V.

Long, William D. *See* Friedman, Irving. 5310

5353 **Lu, Paul H.; Scheidegger, Adrian E.** An intensive local application of Lensen's isallo stress theory to the Sturgeon Lake South area of Alberta: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 389–396, illus., 1965.

Isallo stress maps of an area 24 by 24 miles in Central Alberta, Canada, were drawn to test Lensen's theory. Two types of maps were drawn: one without and one with the *a priori* assumption of a principal horizontal stress (PHS) direction. It is shown that in either case, regions with incipient transcurrent faulting are preponderant over all others, a result which is in conformity with results from recent seismological investigations. The faulting patterns found are in full conformity with those that could be produced by the tectonic stresses which created the Rocky Mountains.—Authors' abstract

5369 **Luft, Stanley J.** Rhizoconcretions in vitric ash–fall tuff, Nye County, Nevada: Geol. Soc. America Bull., v. 77, no. 3, p. 313–318, illus., 1966.

Small, vertically elongate concretionlike structures, here called rhizoconcretions, are found in scattered localities in and near the southern part of the Belted Range of Nye County, Nev. The rhizoconcretions occur within a stratigraphically restricted zone in bedded vitric ash–fall tuff of late Tertiary age. The rhizoconcretions differ in mineralogy from their host rock in that they are cemented by a binder of undetermined composition, possibly a zeolite, whereas the host tuffs are uncemented. These structures appear to have formed during diagenesis of the tuff by means of capillary movement of subsurface waters that reacted with volcanic glass within the conduits to form the cementing material.—Author's abstract

5026 **Lynts, George W.** Relationship of sediment–size distribution to ecologic factors in Buttonwood Sound, Florida Bay: Jour. Sed. Petrology, v. 36, no. 1, p. 66–74, illus., 1966.

Measurements of the ecological factors, depth, temperature, salinity, pH, and Eh were tested for relationship to grain–size properties of associated bottom sediments at nineteen sampling stations in an ocean shore–line environment. Factor–vector analysis showed neither linear relationships within the ecological factors nor between the ecological factors and sediment grain size. A positive relationship was found to exist between siltiness of the sediment and abundance of turtlegrass.—R.A.C.

5017 **Macauley, G.; Penner, D. G.; Procter, R. M.; Tisdall, W. H.** Carboniferous, Chap. 7 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 89–102, illus., geol. map, 1966.

Shallow–water marine sediments dominate the Carboniferous in western Canada, grading from carbonates in the south to shales in the north. Truncated northeasterly,

the most complete sections are subsurface, 5,500 feet in northeastern British Columbia and 4,500 feet in the Rocky Mountains of southwestern Alberta. Three approximate time-stratigraphic units reflect major phases of sedimentation. The lower map-unit, Kinderhookian, is dominantly fine clastics; the middle one, Osagean-Meramecian, is carbonate; and the upper, Chesterian-Pennsylvanian, a coarse clastic sequence. Nomenclature varies with the areas in Alberta, British Columbia, and Saskatchewan. Illustrations include isopach and subcrop distribution maps. Oil and gas within the Plains area is associated with stratigraphic traps at the eroded surface but in the disturbed belt traps are structurally controlled.—G.D.C.

5357 **MacDiarmid, Roy A.** Biogenic Ag_2S—A correction [discussion of paper by L. G. M. Baas Becking and D. Moore, 1961]: Econ. Geology, v. 61, no. 2, p. 405-407, table, 1966.

Bacteriological synthesis of "argentite" reported by Baas Becking and Moore (Econ. Geology, v. 56, p. 259-272) actually yielded acanthite, according to X-ray data given in original article.—W.S.W.

MacDonald, W. D. *See* Springer, G. D. 5349

5063 **MacGregor, A. G.** Memorial to Sir Edward B. Bailey, Kt., M.C.,F.R.S. (1881-1965): Geol. Soc. America Bull., v. 77, no. 3, p. P31-P39, portrait, 1966.

MacKenzie, D. B. *See* Harms, J. C. 5337

MacLeod, Norman S. *See* Snavely, Parke D., Jr. 5179

5056 **Maiklem, W. R.** Clay minerals from some Upper Cretaceous bentonites, southwestern Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 452, 1965.

5038 **Major, Robert L.** Mineral resources and mineral industries of the East St. Louis region, Illinois: Illinois Geol. Survey Mineral Economics Brief 12, 32 p., illus., tables, 1966.

The East St. Louis region includes Madison, St. Clair, and Monroe Counties in southwestern Illinois. Value of mineral production in 1964 was 32.3 million dollars and the minerals produced were, in order of their value, coal, crushed and broken stone, clay products, crude oil, and sand. In addition, the region possesses undeveloped minerals of potential importance such as oil shale, gypsum and anhydrite, feldspar-bearing sands, and pyrite.—*from* Author's abstract

5210 **Maloney, Neil Joseph.** Geology of the continental terrace off the central coast of Oregon [abs.]: Dissert. Abs., v. 26, no. 9, p. 5370, 1966.

5147 **Mancuso, J. J.** Development of magnetite in iron formations of the Lake Superior region [discussion of paper by G. L. Laberge, 1964]: Econ. Geology, v. 61, no. 2, p. 408-409, 1966.

Silica content of siliceous iron formation cannot be equated with chert content since most of silica may actually occur in silicates.—W.S.W.

Martin, K. G. *See* Moore, C. H., Jr. 5405

Martin, R. A. *See* Lane, G. N. 5200

5059 **Mason, Brian.** Memorial to Mark Chance Bandy (1900-1963): Geol. Soc. America Bull., v. 77, no. 2, p. P13-P16, portrait, 1966.

5107 **Matheson, Harry.** A nomogram for determining azimuth and horizontal trace velocity from tripartite measurements: Earthquake Notes, v. 37, no. 1, p. 33-37, illus., 1966.

The direction normal to a traveling plane-wave front, and the wave's horizontal trace velocity at the Earth's surface, are easily determined by observing the wave at three noncollinear points. Reduction of the data involves the solution of several trigonometric equations. This note describes a nomogram which reduces this task to 30 sec with ruler and pencil.—Author's abstract

Mathews, W. H. *See* Taylor, R. Spence. 5020

Mathews, W. H. *See* Barton, Robert H. 5021

5109 **McCamy, K.; Powell, L.; Meyer, R. P.** A note on the ideal compensation of frequency modulated data: Earthquake Notes, v. 37, no. 1, p. 9–16, 1966.

The dynamic range of FM tape systems can be increased by using compensation to reduce the effect of tape speed variations. The normal method of compensation, however, requires precise matching of the record-electronics, and fails to compensate large signals. An ideal compensation system is described which, without requiring important modification of existing FM systems, recognizes the multiplicative nature of distortions caused by tape speed variations and removes them algebraically from both large and small signals. Further, it does not require accurate matching of the record-electronics or of the playback demodulators, and it can be applied to existing data.—Authors' abstract

McCauley, John F. *See* Ridgeway, David C. 5292

McClure, William L. *See* Slaughter, Bob H. 5382

5129 **McCrone, A. W.** Sediments from Long Island Sound (New York)—Physical and chemical properties reviewed: Jour. Sed. Petrology, v. 36, no. 1, p. 234–236, illus., 1966.

Sediments range from sandy to clayey medium grayish-green silts. The upper inch or two is black, rich in organics, and odorous. Quartz, the most abundant mineral, forms 50 to 90 percent of the sediment. Typically, less than 12 percent of the particles are clay size. Clay minerals are illite and chlorite. Water content ranges from 35 percent at a depth of 6 feet to 70 percent near the surface.—R.A.C.

5171 **McCrone, Alistair W.** Water depth and Midcontinent cyclothems, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 275–281, table, 1964 [1966].

In a review of depth-related aquatic environmental factors and sedimentary records of depositional depth, cyclic marine depth changes, modified by climate and presence of physical barriers in water up to approximately 60 feet deep, are defended as the major causes of most Kansas Wolfcampian cyclothems. Eustatic sea-level changes of 60 feet or less are not extraordinary or inexplicably large. Fusulinids in Kansas Pennsylvanian and Permian cyclothems may have lived in waters much shallower than 60 feet, and need not be interpreted as representing times of deepest water and maximum marine transgression.—Author's abstract

5032 **McCrossan, R. G.; Glaister, R. P.; Grey, H.; Nelson, S. J.** (editors). Geological history of western Canada (2d edition): Calgary, Alberta, Alberta Soc. Petroleum Geologists, 232 p., illus., tables, geol. maps, 1966.

Based on papers presented at a symposium in Calgary in 1961, the 16 chapters written by specialists are individually cited. The book is far more than a compilation and gives valuable new data and broad regional interpretations into which specific local studies fit. The area covered extends roughly from the 49th to the 60th parallel and from the Precambrian Shield to the Pacific Ocean, excluding the Northwest Territories where extensive drilling may change geologic concepts materially. Despite limited available data, the geology of the Cordillera holds the key to interpretation of the Plains region which covers the entire stratigraphic section from Archean to Quaternary.—G.D.C.

McCrossan, R. G. *See* Nelson, S. J. 5346

McCubbin, D. G. *See* Harms, J. C. 5337

5018 **McGugan, A.; Roessingh, H. K.; Danner, W. R.** Permian, Chap. 8 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 103–112, illus., 1966.

The Permian of western Canada may be grouped under three areas: thin miogeosynclinal sedimentary rocks of the Rocky Mountain Front Ranges, subsurface beds of the Peace River region, and thick eugeosynclinal sedimentary and volcanic rocks of interior British Columbia and the Pacific coast. The Ishbel Group in western Alberta consists of six formations, herein described and correlated with northwest U.S.A., Yukon, and Canadian Arctic formations. The oil and gas producing Belloy Formation, up to 400 feet thick in the Peace River subsurface, contains megafauna and microflora of probable middle Permian age. The Cache Creek Group in British Columbia is so structurally complex that no complete section has been worked out; the limestones contain brachiopods and fusulinids ranging in age from Wolfcampian to Ochoan or younger.—G.D.C.

5013 **McGuire, William H.** Relationship of oil and gas production to major gravity anomalies in western Kentucky, *in* Kentucky Oil and Gas Assoc., 28th Ann. Mtg., 1964, Tech. Sess. Proc.: Kentucky Geol. Survey, ser. 10, Spec. Pub. 10, p. 65–69, illus., 1965.

The broad areas of oil and gas production in western Kentucky are associated with large Bouguer gravity anomalies (about 15 mg) which probably reflect deep faulting or other basement tectonics.—Author's abstract

5195 **McGuire, William H.** Porosity zones in the Knox Dolomite of northeastern Kentucky, *in* Kentucky Oil and Gas Assoc., 28th Ann. Mtg., 1964, Tech. Sess. Proc.: Kentucky Geol. Survey, ser. 10, Spec. Pub. 10, p. 94–96, 1965.

The Knox Dolomite of northeastern Kentucky contains zones of vuggy, intercrystalline, intergranular, oolitic, and fracture porosity, and exhibits potential trapping conditions that indicate it is capable of producing oil and gas in commercial quantities.—Author's abstract

5172 **McKee, Edwin D.** Permian and Triassic cycles involving chemical sediments, northern Arizona, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 283–286, illus., 1964 [1966].

Cyclic sedimentation, which results from alternation or repetition of environments of deposition, is common where certain naturally concentrated salts are deposited periodically with contemporaneously accumulating detrital deposits to form beds in a definite sequence. Some chemical sedimentary rocks included in cyclic sequences are limestone, gypsum, and chert, as illustrated by the Toroweap, Moenkopi, and Kaibab Formations, respectively, in northern Arizona. These cyclic sequences generally differ from those formed by changes in sea level in that they are mostly simple, usually involving only two or three lithologic units in each cycle, and in that they have relatively restricted geographic distribution. The cyclically deposited units may be repeated many times in a stratigraphic interval, however, and attain a large total thickness.—Author's abstract

4991 **McLaren, Eugene.** Stabilization of aragonite by magnesium ion [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 265–266, 1966.

McVey, W. H. *See* Faulkner, R. L. 5412

Meents, Wayne F. *See* Graf, Donald L. 5392

5211 **Melchior, Robert Charles.** Pollen and spores of the Shawmut anticline, Montana [abs.]: Dissert. Abs., v. 26, no. 9, p. 4993–4994, 1966.

5006 **Merriam, Daniel F.; Lippert, R. H.** Geologic model studies using trend-surface analysis: Jour. Geology, v. 74, no. 3, p. 344–357, illus., tables, 1966.

The structural history of two areas in Kansas has been studied by means of trend-surface analysis. The trends are fitted to structural data from various stratigraphic horizons. Structural breaks are indicated by dissimilar trends. Other aspects of the structural development are revealed by isopach data. Maps of trend-surface residuals indicate local structural features, and are compared by means of coefficients of association. The rate of change of residual magnitudes points to the direction of basin margins.—A.T.M.

Merriam, Daniel F. *See* Imbrie, John. 5167

5186 **Merriam, Daniel F.** (editor). Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, no. 1–2, 636 p., illus., tables, 1964 [1966].

The symposium contains 38 papers 27 of which are areal in nature. All areas are in North America, except one Alpine study. The general papers cover various aspects of cyclic sedimentation and methods of study.—E.S.L.

5258 **Mettler, Don E.** West Moorcroft Dakota field, Crook County, Wyoming: Mtn. Geologist, v. 3, no. 2, p. 89–92, illus., 1966.

A permeability trap in Dakota Sandstone (Lower Cretaceous) at West Moorcroft field will produce about 10,000,000 bbls of oil during its lifetime from an area covering less than 600 acres. The reservoir has average porosity of 24 percent and permeability ranging up to more than one darcy; it is enclosed within porous sandstones as are all other prolific Dakota stratigraphic oil traps on the Powder River basin's east flank. All evidence indicates the West Moorcroft Dakota pool is trapped in a stream-channel point-bar sandstone deposit by barrier rock composed of fine-grained sediments representing the sedimentary fill-up of an ancient abandoned channel or oxbow lake.—*from* Author's abstract

Meyer, R. P. *See* McCamy, K. 5109

Meyers, N. *See* Barss, D. L. 5019

5212 **Michels, Joseph William.** Lithic serial chronology through obsidian hydration dating [abs.]: Dissert. Abs., v. 26, no. 9, p. 4959, 1966.

Mijailovskaya, Marina S. *See* Furrazola-Bermudez, Gustavo. 5338

5087 **Miller, D. N., Jr.** Recognition and classification of marginal marine environments, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 209–218, illus., 1965.

Recognition of marginal marine environments depends on the establishment of a single or concurrent series of strand-line positions that separate terrestrial and marine deposits. Primary planar surfaces parallel to the ancient sea level, can be established using lithologic and biologic criteria, which are summarized in the paper, and by using these surfaces as reference horizons, a better perspective of the depositional site and the pattern of distribution may be gained.—E.S.L.

5153 **Miller, Gerald M.** Structure and stratigraphy of southern part of Wah Wah Mountains, southwest Utah: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 858–900, illus., 1966.

Two thrust faults divide the area into three distinct units: an "autochton", which consists of clastic Mesozoic strata; the lower, or Blue Mountain, thrust plate, which is an easterly facies of the Paleozoic sequence of the eastern Great Basin and which ranges in age from Middle Cambrian to Early Pennsylvanian; and the upper or Wah Wah thrust plate, which consists of rocks of latest Precambrian to Cambrian age. The Blue Mountain thrust has a minimum horizontal displacement of nine

miles. The Wah Wah, House, and Confusion Ranges are assigned to the Wah Wah thrust plate.—W.C.C.

Minard, James P. *See* Finch, Warren I. 5237

Miroliubov, Yuri S. *See* Furrazola-Bermudez, Gustavo. 5338

Montagu, M. F. Ashley. *See* Brace, C. L. 5374

Montgomery, Florence. *See* Stanley, Edward A. 5090

5405 **Moore, C. H., Jr.; Martin, K. G.** Comparison of quartz and carbonate shallow marine sandstones, Fredericksburg Cretaceous, central Texas: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 981–1000, illus., table, 1966.

Lower Fredericksburg Cretaceous of central Texas contains two shallow marine sandstone deposits of similar shape but contrasting lithologic character, genesis, and porosity trend. The lower sandstone (Paluxy Formation) is predominantly quartz sand and clay, a tongue-like projection southward from the main part of the formation, part of the transgressive phase, deposited by longshore currents, modified by wave and tidal action in a coastal nearshore environment. Porosity trends parallel the length of the body. The upper sandstone (Whitestone Limestone Member of the Walnut Formation) is made of carbonate grains (ooliths, pellets, shell fragments), an elongate mound-shaped body trending southeast, part of the regressive phase, deposited in an agitated, offshore, shallow environment by southeast-trending currents, modified locally by surge channels normal to this trend. . . .—Authors' abstract

5065 **Moore, Paul B.** The crystal structures of laueite and metastrengite and a crystallochemical classification of Fe-Mn orthophosphate hydrates [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 266, 1966.

5173 **Moore, Raymond C.** Paleoecological aspects of Kansas Pennsylvanian and Permian cyclothems, *in* Symposium on cyclic sedimentation: Kansas Géol. Survey Bull. 169, v. 1, p. 287–380, illus., 1964 [1966].

The recognition of more than 100 cyclothems in the Pennsylvanian and Lower Permian succession of Kansas, each containing a number of distinctive types of deposits and varied assemblages of organic remains, provides opportunity for trustworthy paleoecological observations and interpretations, because repetitive occurrences of identical or near-identical sedimentary environments and biotopes can be analyzed comparatively and because sequential relationships of these environments and biotopes within the different cyclothems aid in confirming interpretations. Traceability of thin layers for long distances along outcrops allows study of geographic constancy of individual biotopes or departure from constancy. Approximately 20 representative ecologic communities (ecosystems) are characterized briefly and their stratigraphic occurrence is illustrated diagrammatically.—*from* Author's abstract

5213 **Morey, Glenn Bernhardt.** The sedimentology of the Precambrian Rove Formation in northeastern Minnesota [abs.]: Dissert. Abs., v. 26, no. 9, p. 5370–5371, 1966.

5358 **Morris, A.** The geology of the Black Bear Island Lake area (east half), Saskatchewan: Saskatchewan Dept. Mineral Resources Rept. 86, 24 p., illus., geol. map, 1965.

Consolidated rocks of the Black Bear Island Lake area are Precambrian; unconsolidated glacial deposits, recent alluvium, and vegetation provide a mantle that masks more than two-thirds of the land area. Oldest rocks are metamorphosed sediments, chiefly migmatites, underlying about two-thirds of the map area; granitic rocks comprise about one-third of the outcrop area. Pegmatite dikes and sills, youngest consolidated rocks, occur in abundance and intrude all rock units but only rarely comprise mappable bodies. Metasedimentary and many granitic rocks have a gneissic structure attributed to metamorphism of originally layered or foliated sedimentary rocks; dominant trend of this structure is northeasterly. The only

metallic mineralization observed consists of several extensive, rusty weathering zones of disseminated pyrite–pyrrhotite. No geophysical surveys have been flown over the area.—M.C.M.

Moyer, G. L. *See* Belyea, Helen R. 5343

5325 **Mrose, Mary E.; Vlisidis, Angelina C.** Proof of the formula of shattuckite, $Cu_5(SiO_3)_4(OH)_2$ [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 266, 1966.

5060 **Nace, Raymond L.** Memorial to Radcliffe Harold Beckwith (1900–1964): Geol. Soc. America Bull., v. 77, no. 2, p. P17–P22, portrait, 1966.

Nafziger, Ralph H. *See* Speidel, David H. 5187

Nalwalk, A. J. *See* Bowin, C. O. 5306

Nation, J. B. *See* Hales, A. L. 5108

5149 **Neathery, Thornton L.** Sulfide mineralization in the Cragford district, Clay and Randolph Counties, Alabama [abs.]: Alabama Acad. Sci. Jour., v. 36, no. 4, p. 181, 1965.

5252 **Nelson, C. A.** Geologic map of the Waucoba Mountain quadrangle, Inyo County, California: U.S. Geol. Survey Geol. Quad. Map GQ–528, scale 1:62,500, sections, 1966.

5190 **Nelson, D. J.; Rains, T. C.; Norris, J. A.** High-purity calcium carbonate in freshwater clam shell: Science, v. 152, no. 3727, p. 1368–1370, tables, 1966.

The calcium carbonate in freshwater clam shells is similar in purity to that designated reagent grade. A simple reprecipitation of the shell extract results in a product having less Sr and Mg than reagent grade $CaCO_3$. Clams are harvested commercially, and discarded shells are a high-quality raw material for the production of $CaCO_3$.—F.W.C.

5155 **Nelson, Robert B.** Structural development of northernmost Snake Range, Kern Mountains, and Deep Creek Range, Nevada and Utah: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 921–951, illus., tables, geol. map, 1966.

Precambrian and Paleozoic rocks occur in two major structural units in the Kern Mountains and Snake Range and in three major units in the Deep Creek Range. Correlation across the intervening Pleasant Valley of the thrusts that define these units can only be inferred. Rocks older than the Prospect Mountain Quartzite are regionally metamorphosed, and rocks as young as the Devonian Guilmette Formation have been subjected to low-grade, probable contact, metamorphism. Metamorphism is believed to be post-Paleozoic. These metamorphosed rocks acted as a rigid basement above which allochthonous rocks were deformed and thrust along several décollement toward the east-southeast.—E.K.M.

Nelson, S. J. *See* McCrossan, R. G. 5032

5346 **Nelson, S. J.; Glaister, R. P.; McCrossan, R. G.** Introduction, Chap. 1 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 1–13, illus., tables, geol. map, 1966.

This introductory chapter includes a regional correlation chart, an historical summary of the geology, structural cross sections, a brief outline of the distribution of oil and gas, coal, and other mineral resources, and a map of the metallogenic provinces (after Lang, 1960).—G.D.C.

5276 **Newcome, Roy, Jr.; Sloss, Raymond.** Water resources of Rapides Parish, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. 8, 104 p., illus., tables, 1966.

In Rapides Parish fresh water in Miocene rocks is available to depths ranging from 200–3,200 feet; permeability ranges from 90–1,000 gpd per sq ft, transmissibility from 1,400–60,000 gpd per ft; yields are as great as 600 gpm; water is soft, slightly alkaline, sodium bicarbonate type. Pleistocene upland deposits and Red River valley alluvium cover most of the parish and contain fresh water throughout their thickness (maximum about 200 feet); permeability is generally higher than in Miocene rocks and transmissibility is as much as 100,000 gpd per ft; irregular thickness of sands causes differences in yield; water from upland deposits is soft and acidic and in valley alluvium is calcium magnesium bicarbonate type. Miocene aquifers of the southwest and alluvium of Red River valley are the most important sources of water.—*from* Authors' abstract

Newton, V. C., Jr. *See* Stewart, R. E. 5379

Nichols, M. C. *See* Bideaux, R. A. 5068

5324 **Nichols, M. C.** The structure of tsumebite [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 267, 1966.

5040 **Nielsen, Grant L.** A core of the Mount Head and Livingstone Formations, Highwood River area, Alberta: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 441–447, illus., 1965.

Some thirty test holes were drilled at a location on the Highwood River to determine its suitability as a potential dam site. In most cases the alluvium was cased, and cores taken from the underlying bedrock; enough core was available to provide a composite section more than 400 feet thick. The described section includes strata of the Mississippian Mount Head and Livingstone Formations.—M.C.M.

5404 **Nininger, R. D.; Gabelman, J. W.; Adler, H. H.** Application of geologic concepts to future uranium exploration [with French, Russian, and Spanish abs.], *in* Internat. Conf. Peaceful Uses Atomic Energy, 3d, Geneva, 1964, Proc., V. 12, Nuclear fuels—[Pt.] 3, Raw materials: New York, United Nations, p. 233–241, illus., 1965.

The uranium deposits in sandstone constitute 95 percent of the present reserves in the United States. The source of uranium, its migration, and the geochemical evolution of the deposits are problematical but are critical factors in exploration targets. According to concepts of mineral zoning, most favorable locations for uranium mineralization within tectonic mobile belts are near or along the foreland side. These would lie at low temperature ends of mineral zoning gradients across a regional belt and also more locally associated with smaller uplifts on the gently dipping flank between an uplift and a closed basin of continental deposition. The ideal host rocks are permeable fluviatile sandstones rich in carbonaceous debris. Important districts of the United States are shown in relation to zones of orogenic deformation.—G.D.C.

Noe-Nygaard, Arne. *See* Berthelsen, Asger. 5277

Norford, B. S. *See* Porter, J. W. 5015

Norris, J. A. *See* Nelson, D. J. 5190

5034 **Norris, Robert M.** Barchan dunes of Imperial Valley, California: Jour. Geology, v. 74, no. 3, p. 292–306, illus., tables, 1966.

Barchan dune origin, shape, movement, volume, and relation to physical and climatic environment were studied at two localities. In the Algodones dune chain, barchans develop in hollows between megabarchans and in about 40 years cross the hollows. West of Salton Sea, detailed surveys show that an isolated, persistently slim and asymmetrical dune decreases its overall rate of advance with increase in volume; it should soon enter and be destroyed in Tule Wash. Similar, genetically related dunes nearer Salton Sea, on a less guillied surface, appear more permanent.—D.R.M.

North, F. K. *See* vanHees, Hendrik. 5347

Novojatsky, Ivan P. *See* Furrazola-Bermudez, Gustavo. 5338

Nowacki, W. *See* Wuensch, B. J. 5003

Nuffield, E. W. *See* Brooker, E. J. 5290

Nunez Jimenez, Antonio. *See* Furrazola-Bermudez, Gustavo. 5338

Odell, R. T. *See* Gardiner, M. J. 5005

5114 **Olson, Everett C.** The evolution of life: London, Weidenfeld and Nicolson, 300 p., illus., 1965.

The first part of the book is devoted to the nature of evolution, including the record of life and evolution, and the origin of species. The scope of evolution, including lineages, radiations and extinction, and origins of higher categories is covered in the second part. The concluding section is on man and evolution. A glossary is included.—E.S.L.

5247 **Olson, Everett C.** New Permian vertebrates from the Chickasha Formation in Oklahoma: Oklahoma Geol. Survey Circ. 70, 70 p., illus., tables, 1965.

Eighteen new vertebrate sites are grouped in a line between Blaine and Grady Counties, along the western margin of the Chickasha Tongue, close to the zone of interfingering with formations of the El Reno Group. They include xenacanth and paleoniscoid fishes, gymnarthrid, trimerorhachid, and dissorophid amphibians, and captorhinomorph and pelycosaurian reptiles. Two new genera of Amphibia, and a new species and new genus of Reptilia are named and described. The fauna lived on a delta marginal to the sea in which deposits of the El Reno Group were formed, and somewhat resemble that of the San Angelo Formation of Texas and the earlier Hennessey Formation of Oklahoma.—G.D.C.

5085 **Ore, H. T.** Characteristic deposits of rapidly aggrading streams, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 195–201, illus., 1965.

Channel deposits are discussed because they reflect more nearly the average character of depositional agencies over a period of time. Longitudinal bars, braided streams, and transverse bars are described and the sediment character discussed, especially cross stratification in transverse bars.—E.S.L.

5214 **Osgood, Richard Grosvenor, Jr.** Trace fossils of the Cincinnati area [abs.]: Dissert. Abs., v. 26, no. 9, p. 5371, 1966.

5330 **Ostrom, John H.** Cretaceous vertebrate faunas of Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 35–41, illus., 1965.

Cretaceous history of the Wyoming area is marked by three distinct phases: first, a short interval of subaerial erosion and fluvial deposition; second, a longer interval featuring transgressive shallow seas; and finally, withdrawal of the seas and return to terrestrial conditions. The vertebrate faunas clearly reflect these major environmental changes, and are separated on this basis in the discussion, which includes climatic significance of the faunas.—E.S.L.

5174 **Ostrom, Meredith Eggers.** Pre Cincinnatian Paleozoic cyclic sediments in the Upper Mississippi Valley—A discussion, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 381–398, illus., table, 1964 [1966].

Upper Cambrian and Lower and Middle Ordovician deposits of the Upper Mississippi Valley consist of four recurring lithotopes comprising five sedimentary

cycles: quartzarenites, poorly sorted coarse-grained dolomitic arenites, shales or argillaceous sandstones, and carbonates. They accumulated on a mildly unstable craton in a position roughly parallel to the shoreline that migrated in response to submergence and emergence. The relationships of factors affecting sedimentation are summarized in a diagram. The results of the study present what is believed to be a working hypothesis for interpreting Cambrian-Ordovician stratigraphy in this area.—E.S.L.

5157 **Owen, D. E.** Nomenclature of Dakota Sandstone (Cretaceous) in San Juan basin, New Mexico and Colorado: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 1023–1028, illus., tables, 1966.

Stratigraphic studies of Lower Cretaceous units in the southeastern part of the San Juan basin indicate that the Tres Hermanos Sandstone should be considered as the upper member of the Dakota Sandstone. In the southwestern part of the basin the Twowells Sandstone should be considered as the upper member of the Dakota Sandstone. A persistent tongue of marine shale, separating the Twowells Sandstone Member from the rest of the Dakota Sandstone, is here named the Whitewater Arroyo Shale Member of the Dakota Sandstone.—A.E.R.

Page, Lou Williams. *See* Page, Thornton. 5232

5232 **Page, Thornton; Page, Lou Williams.** (editors). The origin of the solar system: New York, The Macmillan Co., 336 p., illus., tables, 1966.

This third volume of Macmillan's Sky and Telescope Library of Astronomy is made up of articles by numerous authors, that first appeared in the journals, Sky and Telescope, The Sky, and The Telescope. In addition to a review of Earth as a planet and evidences of its origin, there are chapters on the Sun, the Earth's atmosphere, the growth of cosmogony, and life on other worlds. Appendixes give a brief chronology of astonomy, and a glossary.—E.S.L.

5215 **Palmquist, Robert Clarence.** Geomorphic development of part of the Driftless Area, southwest Wisconsin [abs.]: Dissert. Abs., v. 26, no. 9, p. 5372, 1966.

5049 **Pamenter, C. B.** Cephalopods and other fauna from the Exshaw Formation, Jasper Park, Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 448, 1965.

4992 **Papike, J. J.; Stephenson, Neville.** The crystal structure of mizzonite, a calcium and carbonate rich scapolite [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 267–268, 1966.

4993 **Parrish, William.** High dispersion and high intensity powder diffractometry [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 268, 1966.

Parsons, Thomas S. *See* Gans, Carl. 5271

Patrick, Fred W. *See* Word, Darrell R. 5012

Payne, W. R. *See* Rodda, Peter U. 5119

5175 **Pearn, William C.** Finding the ideal cyclothem, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 399–413, illus., tables, 1964 [1966].

Rock sequences can be translated into numerical sequences by associating with each recognized lithology an interger according to a fixed classification scheme. Finite numerical sequences, corresponding to actual measured sections, can then be compared to infinite numerical sequences, corresponding to ideal cyclothemic repetitions. The deviation of the actual from the ideal can be measured by a discordance index defined as the minimum value of the number of missing lithologies. The method is developed, and application is made to measured sections from the Upper Pennsylvanian Lower Permian interval of northeastern Kansas.

Of particular interest is the ideal sequence which corresponds to the ideal cyclothem proposed by R. C. Moore for this region.—E.S.L.

5103 **Pecora, William T.** Current geologic research as a guide for future mineral exploration, *in* Minerals Day collected papers: Skokie, Ill., Internat. Minerals and Chem. Corp., Mining and Explor. Div., p. 54–80, illus., 1965.

Research scientists in public service need years and latitude to develop and make available a general research background of information that directly benefits industry and university sectors of American culture. The basic research program of the U.S. Geological Survey over 85 years has had a direct relation to target research of industry, whether in providing data on geochemical abundance of a trace element, on habits of particular types of ore deposits, or on the geologic setting of a large part of the Earth's crust. Examples of its research are reviewed briefly. The brain power of the PhD's is needed; their proportion among the Geological Survey geologists has doubled in the past 25 years from 20 to 40 percent, and among its new scientists in the last two years is 75 percent.—G.D.C.

Penner, D. G. *See* Macauley, G. 5017

Perrotta, A. J. *See* Gaines, A. M. 4987

Peter, George. *See* Heirtzler, J. R. 5394

Peterman, Z. E. *See* Burwash, R. A. 5010

5055 **Peterman, Z. E.** Precambrian basement of Saskatchewan and Manitoba [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 453, 1965.

4995 **Peterson, G. E.** Fourier technique for the analysis of Zeeman NQR zero crossing data [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 269, 1966.

5141 **Peterson, Warren L.** Geologic map of the New Haven quadrangle, Nelson and Larue Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–506, scale 1:24,000, section, text, 1966.

Shows of oil and gas have been reported in the New Haven quadrangle, but no commercial production has resulted. The shale member of the Borden Formation is a source of large quantities of clay shale suitable for brick and other molded clay products. Dense dolomite in the middle of the Laurel Dolomite has been quarried and used for road metal, asphalt filler, and construction purposes.—M.C.M.

5409 **Pevear, D. R.** The estuarine formation of United States Atlantic Coastal Plain phosphorite: Econ. Geology, v. 61, no. 2, p. 251–256, 1966.

Dissolved inorganic phosphorus concentrations in estuaries are commonly high enough to cause phosphatization of calcium carbonate. The large phosphorus values are due to the high productivity of organisms, especially plants. The areal distribution, stratigraphy, mineralogy, and fossils of the Tertiary Atlantic coastal plain phosphorite support a near-shore, probably estuarine origin for the deposits.—Author's abstract

5269 **Philpotts, A. R.** Origin of the anorthosite-mangerite rocks in southern Quebec: Jour. Petrology, v. 7, no. 1, p. 1–64, illus., tables, 1966.

The anorthosite-mangerite suite, known as the Morin Series in southern Quebec, is described from two contrasting areas, one intensely deformed, and the other only mildly deformed. Differences in mineralogy and chemistry of the rocks in these two areas are related to the degree of metamorphism. Detailed mineralogy of the feldspars and pyroxenes is given, and analyses of the rocks are compared with those of other anorthosite series. It is concluded that the anorthosite-mangerite rocks are derived from a calc-alkaline parental magma that underwent differentiation in a very dry environment, giving rise to a strong iron enrichment trend. The fact that intrusion took place during an orogenic period is of great importance, for rocks

in the more deformed area are more differentiated than those in the less deformed area.—E.S.L.

5288 **Philpotts, J. A.; Pinson, W. H., Jr.** New data on the chemical composition and origin of moldavites: Geochim. et Cosmochim. Acta, v. 30, no. 3, p. 253–266, illus., tables, 1966.

Results of new major-element analyses of 17 Bohemian and 6 Moravian tektites are presented, together with Rb and Sr contents and Rb/Sr ratios. In contrast to the australites, the moldavites show significant negative correlations between alkali metals (Na and Rb) and the alkaline earths. The relationships in the chemical compositions of moldavites are unlike those of sedimentary or igneous rocks. It is suggested that the observed variations in composition are largely due to fractional volatilization. The wide range of Rb-Sr ratios in conjunction with uniformity of Sr isotopic composition supports this theory.—D.B.V.

Pinson, W. H., Jr. *See* Philpotts, J. A. 5288

Pittillo, D. R. *See* Boynton, G. R. 5234

Pittillo, D. R. *See* Boynton, G. R. 5235

5150 **Pitts, M. Michael, Jr.** Structural geology of the Blount Springs inlier, Blount County, Alabama [abs.]: Alabama Acad. Sci. Jour., v. 36, no. 4, p. 181, 1965.

Pocock, Stanley A. J. *See* Staplin, Frank L. 5362

5225 **Popoff, Constantine C.** Computing reserves of mineral deposits—Principles and conventional methods: U.S. Bur. Mines Inf. Circ. 8283, 133 p., illus., 1966.

This review, drawing on published information, evaluates the principles underlying interpretation of data obtained in exploring mineral deposits. It analyzes conventional methods of computing reserves such as analogy, geologic blocks, mining blocks, cross-section, isolines, triangles and polygons, and outlines their applicability to different kinds of deposits. Accuracy of results usually depends more on geologic interpretations and assumptions than on method.—A.P.B.

5015 **Porter, J. W.; Fuller, J. G. C. M.; Norford, B. S.** Ordovician Silurian, Chap. 4 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 34–48, illus., geol. map, 1966.

Most of the Ordovician and Silurian rocks of the Interior Plains lie within the Williston basin, totalling about 2,000 feet at the center where overlain by 12,000 feet of younger strata. Three main stratigraphic units are the Winnipeg (Middle Ordovician), Bighorn (Middle and Upper Ordovician), and Interlake (Silurian) Groups. In the Cordillera most thick geosynclinal sequences in interior British Columbia are metamorphosed with little evidence of age. Shelf carbonates dominate the Middle and Upper Ordovician and Silurian of the Rocky Mountains, but the Lower Ordovician facies suggest deeper water. Graptolitic rocks are locally developed. Remnants of deposits northeast of the shelf carbonates suggest shallow water. Illustrations include isopach and lithofacies maps.—G.D.C.

5156 **Porter, Stephen C.** Stratigraphy and deformation of Paleozoic section at Anaktuvuk Pass, central Brooks Range, Alaska: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 952–980, illus., 1966.

The valley of Anaktuvuk Pass crosscuts the Brooks Range, Alaska, near longitude 152°, exposing 6,300 feet of Upper Devonian non-marine clastics, 4,700 feet of Mississippian marine clastics, carbonates, and chert, and 400 feet of Permian marine clastics. Post-Paleozoic forces from the south produced overturned folds, and both deep seated and shallow low angle thrusts. The oldest rock exposed, the Upper Devonian Hunt Fork Shale, is believed to be the base of a zone of regional décollement. The more shallow (Anaktuvuk) thrust displaces Mississippian and younger rocks northward at least eight miles. Stratigraphic units and structural

features are discussed in detail; bibliography is pertinent and comprehensive.—B.H.K.

4994 **Pouliot, G.** Composition and distribution of feldspars in the Muskox intrusion, N.W.T. [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 268–269, 1966.

Powell, L. *See* McCamy, K. 5109

Preisinger, A. *See* Prewitt, C. T. 4996

5176 **Preston, Floyd W.; Henderson, James H.** Fourier series characterization of cyclic sediments for stratigraphic correlation, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 415–425, illus., tables, 1964 [1966].

Preliminary studies indicate that Fourier analysis can be used to develop a set of numerical parameters that give a reasonably accurate representation of an electric log of a formation and that these parameters may be studied for periodicities. They also may become input data for statistical methods of formation correlation. An example shows the use of the discriminant function to determine whether or not electric log data came from one of two known formations.—E.S.L.

4996 **Prewitt, C. T.; Kirchner, E.; Preisinger, A.** Crystal structure of larsenite, $PbZnSiO_4$ [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 269, 1966.

5253 **Price, R. A.** Geology, Flathead (Upper Flathead, east half), British Columbia–Alberta: Canada Geol. Survey Map 1154A (also in Mem. 336), scale 1:63,360, sections, 1965.

5287 **Price, R. A.** Flathead map-area, British Columbia and Alberta [with French, German, and Russian abs.]: Canada Geol. Survey Mem. 336, 219 p., illus., tables, geol. maps, 1965 [1966].

The map-area is underlain by a sequence of unmetamorphosed sediments, including the Precambrian to Lower Cretaceous succession of the Lewis thrust sheet, the Jurassic to Upper Cretaceous sequence of the Foothills, and an unknown thickness of mid-Tertiary fanglomerates along the downthrown side of the Flathead fault. Two groups of structures occur, the older characterized by thrust faults, and the younger dominated by the Flathead gravity fault. Physiography, glacial geology, and economic geology are discussed briefly. Appendixes contain 19 measured sections, and excerpts from reports on paleontological collections. Structure, tectonic, and geologic maps, with sections and a block diagram accompany the report.—E.S.L.

Procter, R. M. *See* Macauley, G. 5017

5272 **Pulpan, Hans; Scheidegger, Adrian Eugen.** Statistical analysis of seismic faulting: Pure and Appl. Geophysics, v. 61, p. 89–94, tables, 1965.

A calculation of the slip angle and an analysis of the type of faulting associated with earthquakes was made for the presently available fault-plane solutions in the same fashion as this was done six years ago for the then available fault-plane solutions. Most of the earlier results were confirmed. It was found that there exist certain large scale areas in the world which can now be much more specifically defined than previously, with a predominance of either strike-slip or dip-slip faulting. There is no evidence of a level of no strain from seismic data since there is no indication of a distinct decrease of pressure type faulting with increasing depth.—Authors' abstract

5342 **Raasch, Gilbert O.; Unfer, Louis, Jr.** Transgressive-regressive cycle in Croixan sediments (Upper Cambrian), Wisconsin, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 427–440, illus., 1964 [1966].

A preliminary and minimal mechanical analysis study of the St. Croix Series marine arenaceous succession strongly suggests the presence of a number of depositional cycles. The relation of faunal zones and sedimentary cycles is discussed and shown

in tables, especially for discontinuities. Histograms are given. The nonsequence of greatest duration appears to be between the Eau Claire–Galesville and Ironton cycles.—E.S.L.

Race, W. H. *See* Herbert, C. F. 5413

5136 **Rainey, Froelich.** New techniques in archaeology: Am. Philos. Soc. Proc., v. 110, no. 2, p. 146–152, illus., 1966.

Recent developments of techniques for archeological dating, exploration, and interpretation are reviewed. Applications of radiocarbon and other isotopic dating methods, tree-ring dating, thermoluminescence and uranium-decay dating of pottery and glass, neutron activation analysis, geophysical and underwater exploration methods are discussed.—V.M.J.

Rains, T. C. *See* Nelson, D. J. 5190

5096 **Ramspott, L. D.** Tectonic origin of color in pink granites of the Elberton district, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 75–76, 1966.

Randolph, Philip. *See* Werth, Glenn. 5279

5177 **Reed, E. C.; Burchett, R. R.** Stratigraphic sequences in the Pennsylvanian of Nebraska and their relationships to cyclic sedimentation, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 441–447, illus., 1964 [1966].

The stratigraphic sequence, comprising about 810 feet, is shown graphically, lithologic and paleontologic character of formations and members is illustrated, and the percentage of acid soluble material in each zone is shown. The cyclothemic classification of Moore, and use of insoluble residues and calcium carbonate percentages are discussed. Much of the Upper Pennsylvanian deposition appears to have taken place at critical levels.—E.S.L.

5033 **Reeves, C. C., Jr.** Pluvial lake basins of West Texas: Jour. Geology, v. 74, no. 3, p. 269–291, illus., table, 1966.

The most tenable theories of origin proposed for the lake basins of western Texas are that deep linear basins were formed by breaching of "cap rock" along Pleistocene pluvial streams, and that shallow circular basins originated by solution and leaching in blowouts. Large pluvial lake basins normal to ancient prevailing winds were further developed by end current erosion during wet periods; smaller basins and playas in large basins were developed by deflation mainly during the Altithermal. Only small, isolated basins of other origins exist.—D.R.M.

4997 **Regis, A. J.; Sand, L. B.** K-Na phillipsite, Crooked Creek, Oregon [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 270, 1966.

Revelle, Roger. *See* Hess, H. H. 5267

5387 **Richards, Horace G.; Thurber, David L.** Pleistocene age determinations from California and Oregon: Science, v. 152, no. 3725, p. 1091–1092, illus., 1966.

Mollusks have been collected from Pleistocene marine deposits at Tomales Bay, Calif., and Cape Blanco, Oreg. Dating by the carbon-14 and thorium-230—uranium-234 methods suggests that the shells are at least 33,000 years old. The more probable age of the Tomales Bay locality is >50,000 years.—Authors' abstract

5292 **Ridgeway, David C.; McCauley, John F.; Colquhoun, Donald J.** Geology of the Blaney quadrangle, South Carolina: South Carolina Div. Geology Map Ser. MS-11, scale 1:24,000, section, text, 1966.

Two-thirds of the quadrangle is underlain by Coastal Plain sediments, the remainder by low rank metamorphic rocks of the Carolina State Group. The latter is a geosynclinal accumulation of volcanic tuffs, tuffites, flows, argillites, and siltstone in lithologic units of laminated phyllite, felsic tuffite, and bedded argillite. Five

steeply-dipping, northwest-trending Triassic diabase dikes are present. Coastal Plain sediments are the Middendorf Formation (Upper Cretaceous), windblown sand, and alluvium. Poor exposures over the Piedmont portion preclude structural analysis; structure of the Coastal Plain area is essentially homoclinal. The Carolina Slate Group contains a number of materials of present or potential economic value. The best aquifer is the Middendorf Formation.—M.C.M.

5106 **Riecker, R. E.** Evidence bearing on deep earthquake origin—Weakening of olivine by serpentine dehydration: Mtn. Geologist, v. 3, no. 1, p. 43–46, illus., 1966; also in Earthquake Notes, v. 37, no. 1, p. 3–9, 1966.

A shear press has been used to determine the mechanical behavior of serpentinized dunite and forsterite at normal pressures to 50 kb, temperatures to 900°C, and strain rates from 10^{-1} sec^{-1} to 10^{-4} sec^{-1}. Less than 5 percent by weight serpentine reduces shear strength by at least 30 percent as the temperature is raised from 300°C to 520°C due to reduction of effective normal stress within the compressed wafers. Abundant kink bands (T=(100); t=[001]) develop at normal pressures above 35 kb, and at lower pressures as the temperature is increased. Mechanical behavior of upper mantle mineral analogs suggests that earthquakes deeper than 10 km are not produced by ordinary faulting, but may be associated with deformation of "weak" hydrous phases.—Author's abstract

5198 **Rigby, Keith J.** *Protospongia hicksi* Hinde from the Middle Cambrian of western Utah: Jour. Paleontology, v. 40, no. 3, p. 549–554, illus., 1966.

A large, well preserved fragment of the lyssakid sponge was collected from the Middle Cambrian Marjum Formation in the House Range of western Utah. Molds of articulated spicules occur in a slab of hornfels. The specimen consists of five ranks of cruciform stauract spicules and a layer of rod-like spicules. Spicule rays form roughly rectangular quadrules, averaging 1 cm, 5 mm, 2 mm, 1 mm, and 0.5 mm for each of the five orders. Largest spicules overlie all smaller ones in regular progression. Individual spicules are composed of four gently tapering rays and each overlap adjacent spicules from one-third to two-fifths their length. Spicules were probably united by fleshy material. There is no evidence of interweaving between orders.—R.C.D.

5265 **Rincon-Orta, Cesar.** Contribuciones del Laboratorio de Geocronometria—Pt. 1, Discusion de principios y descripcion de la determinacion geoquimica de edad por el metodo plomo-alfa o Larsen: Mexico Univ. Nac. Autonoma Inst. Geologia Bol. 73, p. 1–56, illus., tables, 1965.

Concepts most fundamental to application of geochronometry are defined and the development of principal equations and formulas used in age calculations is demonstrated. The Larsen lead-alpha method and justification for use of values assigned to the constants c and k are described. The methods used for isolating samples of single minerals and for making comparisons of radioactivity are explained. A description of the spectrographic method of determining lead content in zircon closes the paper.—*from* Author's Spanish abstract

Rincon-Orta, Cesar. *See* Fries, Carl, Jr. 5418

5074 **Ritzma, Howard R.** Geologic significance, No. 1 Raeder-Gov't., Dry Mountain anticline, Moffat County, Colo., *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 131–135, illus., 1965.

Structural information reveals that formations penetrated by this well—the Cretaceous Lewis Shale and Mesaverde Group—were below the Cathedral Bluffs Member of the Wasatch Formation instead of the Fort Union as reported. The well penetrated the lip of the Sparks-Uinta overthrust sheet, buried beneath the Tertiary. The electric log of the well and a cross section normal to the axis of Dry Mtn. "anticline" are included.—E.S.L.

5075 **Ritzma, Howard R.** Fossil soil at base of Paleocene rocks, southern Rock Springs uplift, Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock

Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 136–139, illus., 1965.

The Paleocene Fort Union Formation gradually overlaps 700 feet of Lance Formation and 1,100 feet of Lewis Shale. The basal fossil soil is developed and preserved primarily on the latter. The soil may be one to four feet thick, and the shale is weathered to a depth of four to six feet. A generalized section from Sweetwater County showing the fossil soil zone is included.—E.S.L.

5119 **Rodda, Peter U.; Fisher, W. L.; Payne, W. R.; Schofield, D. A.** Limestone and dolomite resources, Lower Cretaceous rocks, Texas: Texas Univ. Bur. Econ. Geology Rept. Inv. 56, 286 p., illus., tables, geol. maps, 1966.

Limestone is one of the most important nonfuel mineral resources in Texas; the Lower Cretaceous is the source of more than 40 percent of the State's production, distributed over 69 counties. Best quality stone is in the Edwards, Devils River, and Salmon Peak Formations, of which the only significant deposits are in the Edwards Formation. Other Lower Cretaceous limestones generally are too soft for aggregate and insufficiently pure for use as chemical grade stone. Chemical analyses are reported for about 1,000 samples from 246 localities in 49 counties. Measured sections are briefly described. Total tonnage of Lower Cretaceous limestone in outcrop in Texas amounts to 8 trillion tons, about 40 percent of which is high-calcium; of dolomite, 450 billion tons of which at least 16 percent is high magnesium.—G.D.C.

5254 **Roddick, J. A.** Geology, Pitt Lake (Vancouver, east half), British Columbia: Canada Geol. Survey Map 1151A (also in Mem. 335), scale 1:253,440, 1965.

5255 **Roddick, J. A.** Geology, Vancouver North, British Columbia: Canada Geol. Survey Map 1152A (also in Mem. 335), scale 1:63,360, 1965.

5256 **Roddick, J. A.** Geology, Coquitlam, British Columbia: Canada Geol. Survey Map 1153A (also in Mem. 335), scale 1:63,360, 1965.

5366 **Roddick, J. A.** Vancouver North, Coquitlam, and Pitt Lake map-areas, British Columbia, with special emphasis on the evolution of the plutonic rocks [with French and German abs.]: Canada Geol. Survey Mem. 335, 276 p., illus., tables, geol. maps, 1965.

This report combines results of reconnaissance mapping and a petrographic study of plutonic rocks that underlie about 80 percent of the map-areas. These rocks are classified with emphasis on ferromagnesian minerals. The prevailing genetic order in plutonic-rock minerals is plagioclase-hornblende-biotite-quartz-K feldspar. A study of the main minerals in different types has revealed a distinct evolution. Dikes are synplutonic, altered by the rocks they cut. The principal conclusion of the work is an outline of the origin and evolutionary paths of the plutonic rocks. They were created from pre-existing metamorphic rocks and evolved during a long period of retrograde metamorphism corresponding to the uplift of the Coast Mts. It appears that plutonic rocks and common sulfide deposits may be genetically connected.—E.S.L.

4998 **Roddy, David J.** An unusual dolomitic basal facies of the Chattanooga Shale in the Flynn Creek structure, Tennessee [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 270, 1966.

5216 **Roderick, Gilbert Leroy.** Water vapor-sodium montmorillonite interaction [abs.]: Dissert. Abs., v. 26, no. 9, p. 5330, 1966.

5076 **Roehler, Henry W.** Early Tertiary depositional environments in the Rock Springs uplift area, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 140–150, illus., 1965.

Descriptions of the eight environments of deposition recognized in the Rock Springs uplift area are given. Relationships of the members of the Wasatch and Green

River Formations in the southwest part of the area are described, and the paleontology discussed. A map showing the paleogeographic locations of the lakes, a restored section of the lower Eocene, and a nomenclature chart accompany the paper.—E.S.L.

5125 **Roehler, Henry W.** Summary of pre-Laramide Late Cretaceous sedimentation in the Rock Springs uplift area, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 10–12, illus., 1965.

The Baxter Shale comprises the bulk of Late Cretaceous marine deposition in the area. Formations in the Mesa Verde Group and intertonguing Lewis Shale are described briefly. A slow, final retreat of the Cretaceous sea is indicated by the step-like deposition of littoral and shallow marine sandstones of the Fox Hills. A restored section is included.—E.S.L.

Roessingh, H. K. *See* McGugan, A. 5018

Roscoe, S. M. *See* Griffith, J. W. 5158

Rose, Arthur W. *See* Herreid, Gordon. 5035

5194 **Rose, William D.** Highlights of western Kentucky oil and gas exploration in 1963 and early 1964, *in* Kentucky Oil and Gas Assoc., 28th Ann. Mtg., 1964, Tech. Sess. Proc.: Kentucky Geol. Survey, ser. 10, Spec. Pub. 10, p. 41–52, illus., tables, 1965.

Recent exploratory successes in and around Hopkins County, Ky., have spurred interest and activity in this area of western Kentucky. The 298 exploratory tests drilled in 1963 resulted in discovery of 12 oil and 4 gas pools, and 52 new reservoirs and/or extensions. Richland pool, in Hopkins County, the most important discovery in 1963, produced 240,000 bbls of oil to March 1, 1964, from 29 wells. From January to April 1964 there were 4 new-pool discoveries and 12 new pays and/or extensions. Future exploration will likely occur in active areas, and also in largely untested areas along the Moorman syncline.—*from* Author's abstract

4999 **Ross, M.; Wones, D. R.; Takeda, H.** Systematic description and identification of mica polytypes [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 270–271, table, 1966.

5135 **Ross, Reuben James, Jr.; Dutro, J. Thomas, Jr.** Silicified Ordovician brachiopods from east-central Alaska: Smithsonian Misc. Colln., v. 149, no. 7, 22 p., illus., 1966.

A small assemblage of silicified brachiopods from a thin-bedded limestone unit north of Tatonduk River, along the Canadian border, is possibly of late Middle or early Late Ordovician age. Species of *Dicoelosia, Ptychopleurella, Cyclospira, Ptychoglyptus, Diambonia, and Christiana* are very like those described by Schuchert and Cooper (1930) and Cooper and Kindle (1936) from Percé, Quebec. Except for *Dicoelosia*, species of the above genera plus *Catazyga, Anoptambonites, and Xenambonites* suggest correlation with rocks of Caradoc age at Girvan, Scotland. Essentially correlative Ordovician strata exposed along the Tatonduk River seven miles southwest are black graptolitic shales.—V.M.J.

5350 **Rudkin, R. Alan.** Lower Cretaceous, Chap. 11 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 156–168, illus., geol. map, 1966.

Essentially conformable Lower Cretaceous sedimentary rocks of western Canada illustrate a transitional history of orogeny, emergence and non-marine sedimentation through gradual marine transgression to a final epicontinental inundation. The series east of the Rocky Mountains is entirely sedimentary, non-marine beds derived from the Canadian Shield and from Cordilleran uplifts, progressively onlapped by deposits of a boreal sea. Here petroleum and natural gas are of considerable economic importance. Much of the section in the southern interior of British Columbia contains volcanic rocks. The Cordilleran uplifts with extensive batholithic complexes, some of Early Cretaceous age, provided sediments to the adjacent basins

and partly controlled deposition both east and west of the Rockies. A correlation chart and isopach and lithofacies maps are included.—G.D.C.

Ruppert, Gerald B. *See* Clark, George B. 5313

5226 **Sabins, Floyd F., Jr.** Review of petrographic criteria for Cretaceous depositional environments, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 27–34, illus., 1965.

The petrographic criteria reviewed in this paper are based on the writer's published investigations of Upper Cretaceous strata in the San Juan Basin. Since all of the Western Interior was covered by the same seaway, the San Juan Basin provides a useful set of criteria for the Rock Springs uplift. The Hosta–Point Lookout symmetrical cycle and Mulatto–Dalton asymmetrical cycle are described, annd from them criteria for recognizing nonmarine, regressive, and transgressive sandstones are defined.—E.S.L.

5395 **Sahinen, U. M.; Johns, W. M.; Lawson, D. C.** Geochemical reconnaissance stream-sediment sampling in Flathead and Lincoln Counties, Montana: Montana Bur. Mines and Geology Bull. 48, 15 p., illus., 1965.

Samples of stream sediment were collected at half-mile intervals along all drainages in three areas in northwestern Montana—the Yaak River area in the Purcell Mountains and the Star Meadows and Hog Heaven areas in the Salish Mountains. Total project area was 818 sq mi, and 1,284 samples were collected. Samples were analyzed for total heavy metals by the citrate method and for copper, lead, and zinc (individually) by the pyrosulfate-fusion method. A few selected samples were analyzed for beryllium and molybdenum. Further investigation of twenty-five specific localities by soil sampling is recommended.—Authors' abstract

5133 **Sahu, Basanta K.** Transformation of weight frequency and number frequency data in size distribution of studies of clastic sediments—A reply to the "Discussion" by M. A. Dixon [1966]: Jour. Sed. Petrology, v. 36, no. 1, p. 274, 1966.

Dixon's comments are justified when the results of small sample studies are extrapolated to apply to a parent population. The original paper (ibid., v. 34, p. 768–773, 1964), however, did not suggest such extrapolation.—R.A.C.

5274 **Saint John, Bill E.** Geologic map of Black Gap area, Brewster County, Texas: Texas Univ. Bur. Econ. Geology Geol. Quad. Map 30, scale 1:62,500, sections, separate text, 1965.

Outcropping strata of the Black Gap area are principally Cretaceous but include Tertiary volcanic rock and Quaternary alluvium. Unconformably overlying the deformed Paleozoic rocks are marine Comanchean strata which continue upward into the Gulf Series (Terlingua Group). Tertiary igneous and volcanic rocks are part of an alkalic kindred; small differences in mineral composition could be a result of pre-intrusive differentiation. Basically the area is a large northwest-trending graben flanked by a stable block to the northeast and a series of tilted fault blocks to the southwest. Mineral resources are summarized briefly.—M.C.M.

5246 **Salas, Guillermo P.** Resultados de trabajos realizados durante el ejercicio 1964 y programa para 1965: Mexico Univ. Nac. Autonoma Inst. Geologia Anales, v. 23, 31 p., illus., 1965.

The activities of the Institute of Geology at the National University of Mexico for 1964 in the various fields of geology are summarized briefly, and the program for 1965 is outlined.—M.C.M.

5000 **Salotti, Charles A.; Hurst, Vernon J.** Clinohumite from Cotopaxi, Colorado [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 271, 1966.

Sand, L. B. *See* Regis, A. J. 4997

5111 **Santos, Elmer S.** Geologic map of the San Lucas Dam quadrangle, McKinley County, New Mexico: U.S. Geol. Survey Geol. Quad. Map GQ–516, scale 1:24,000, 1966.

The map sheet includes a schematic diagram showing stratigraphic relations of Mesaverde Group and Mancos Shale, and a chart of thickness of lithologic units, in feet.—M.C.M.

5417 **Sarjeant, William A. S.** The supposed "sponge spicules" of Merrill, 1895, from the Lower Cretaceous (Albian) of Texas: Breviora, no. 242, 15 p., illus., 1966.

A re-examination of Merrill's original work, and study of three surviving chert sections, make it clear that of the 36 microscopic structures he figures and describes, only three can be regarded as sponge spicules. Nine and possibly four others represent dinoflagellate cysts. The remaining 20 are of very diverse character. The currently valid species of dinoflagellate cysts are mainly hystrichospherids, all likely to occur in Middle to Upper Albian preparations.—G.D.C.

5260 **Saunders, R. H.** A geochemical investigation along the Taylor Highway, east-central Alaska: Alaska Div. Mines and Minerals Geochem. Rept. 9, 17 p., illus., table, 1966.

Past prospecting in the area now served by the Taylor Highway was mainly for placer gold; prevalent soil and vegetation cover is a serious obstacle to prospecting for lode deposits. Gold mineralization is considered to be associated with intrusion of Mesozoic granitic rocks. In the western part of the Yukon-Tanana region, a second period of mineralization was associated with Tertiary intrusives. During this investigation, 217 samples were taken; 84 contained one or more metals in anomalous amounts. Data on the samples may be subject to more than one interpretation; results indicate, however, that about 20 separate areas are worthy of special attention by prospectors. Results of analyses are summarized in a table and sketch maps indicate anomalous stream sediment samples.—M.C.M.

Schairer, J. F. *See* Bailey, D. K. 5268

Scheidegger, Adrian E. *See* Lu, Paul H. 5353

Scheidegger, Adrian Eugen. *See* Pulpan, Hans. 5272

Schofield, D. A. *See* Rodda, Peter U. 5119

Schürmann, K. *See* Hellner, E. 5329

5217 **Sellers, George August.** Hydrothermal experiments on the thermal stability of amino substances in sediments [abs.]: Dissert. Abs., v. 26, no. 9, p. 5372, 1966.

Sharp, Byron J. *See* Crittenden, Max D., Jr. 5110

5371 **Shaw, Alan B.** Further notes on the Hungerford Slate fauna [correction to "Paleontology of northwestern Vermont," Pt. 8, 1962]: Jour. Paleontology, v. 40, no. 2, p. 294, 1966.

Two trilobites of the Cambrian Hungerford Slate fauna were referred to in the 1962 paper (ibid., v. 36, no. 2, p. 314) by different names from those used in the locality descriptions. They are here listed by the correct names: *Catillicephala ovoides* (Raymond), 1937, as in the systematic description (not *C. lata*); *"Idahoia" minor* Raymond, 1937, as originally named by Raymond, but with the genus in doubt (not *"Elrathia" longa* Howell, 1937, as in the systematic description, nor *Vermontella? minor* (Raymond) Shaw, 1962, as in the locality description).—V.M.J.

Sherwin, D. F. *See* Grayston, L. D. 5016

5227 **Simak, Clifford D.** Trilobite, dinosaur and man—The Earth's story: New York, St. Martin's Press, 306 p., illus., 1966.

Some of the theories for formation of the universe and the solar system are reviewed. The forces that shaped the Earth and methods of finding the age of rocks are described. Beginning with the fossil record, the story of the Earth and life on it is followed from Precambrian to the Ice Age, concluding with a chapter on man.—E.S.L.

5036 **Siple, George E.** Salt-water encroachment in coastal South Carolina, *in* Hydrologic activities in the South Carolina region, Conf. 1965, Proc.: Clemson, S. C., Clemson Univ., Council Hydrology, p. 18–33, illus., table, 1965.

Late Cretaceous sand aquifers and Tertiary limestone and sand aquifers beneath coastal South Carolina have been encroached in varying degree by sea water during Recent and past geologic epochs. Controlling elements of encroachment are geologic structure and stratigraphy, differences in permeability and fresh-water head, incisement of confining beds by streams and estuaries, and depth of aquifer below sea level. Most extensive encroachment occurs in Tertiary limestone and sand aquifers between Beaufort and Charleston. Deepest occurrence of fresh water on the Atlantic Coastal Plain is at 2,800 feet in a well at Parris Island, S. C., where the highest chloride concentration (8,500 ppm) was observed in water from any aquifer of the State at a depth of about 1,000 feet. In contrast to other Atlantic or Gulf Coast States, coastal plain sediments of South Carolina contain a greater volume of fresh water than salt water.—*from* Author's abstract

Sironi, G. *See* Colombo, U. 5145

5382 **Slaughter, Bob H.; McClure, William L.** The Sims Bayou local fauna—Pleistocene of Houston, Texas: Texas Jour. Sci., v. 17, no. 4, p. 404–417, illus., tables, 1965.

Sims Bayou, a tributary to Buffalo Bayou, was straightened and widened in Houston in 1958 revealing excellent exposures of extensive Pleistocene deposits previously obscured by colluvium. Fauna recovered included gastropods, pelecypods, fishes, amphibians, reptiles, and mammals. The mammals are described. A radiocarbon date on charcoal chips recovered during the quarrying is in excess of 23,000 yr B.P. However, since the common cotton rat, *Sigmodon hispidus*, abundant in the Sims Bayou assemblage, has its oldest reported southwestern occurrence in the Moore Pit local fauna, the Houston assemblage may be placed approximately between 50,000 and 25,000 yr B.P.—M.C.

Slaughter, M. *See* Kane, W. T. 4988

5178 **Sloss, L. L.** Tectonic cycles of the North American craton, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 449–460, illus., table, 1964 [1966].

The stratigraphic record on the North America craton from late Precambrian to present is divisible into six sequences which reflect changing patterns of tectonic behavior. Investigation of the distribution of lithologic associations in the successive sequences reveals no systematic repetition suggestive of cyclicity. However, interpretation of the sequences in tectonic terms permits recognition of two models. Four sequences are referable to an epeirogenic model comprising five tectonic stages. Two sequences are relegated to an orogenic model characterized by an apparent lack of order and system in the succession of tectonic events. No relationship is evident between tectonic events in adjoining mobile belts and the North American craton.—Author's abstract

Sloss, Raymond. *See* Newcome, Roy, Jr. 5276

5116 **Smith, Allyn G.** Harold Hannibal, 1889–1965: Sterkiana, no. 21, p. 1, 1966.

5280 **Smith, Harold M.** Crude oil, qualitative and quantitative aspects—The petroleum world: U.S. Bur. Mines Inf. Circ. 8286, 41 p., illus., tables, 1966.

The known qualitative composition of petroleum, and some quantitative aspects, are described and discussed with the aid of illustrations of relationships and structural formulas of identified hydrocarbon and non-hydrocarbon compounds.

Suggested research needs include both qualitative and quantitative studies of nitrogen and oxygen compounds; of hydrocarbon composition, including those compounds that may reflect environmental conditions; and of sulfur compounds, with related studies of the amount and types of sulfur present in terrestrial and marine organic matter.—E.R.L.

5001 **Smith, J. V.** Microprobe correction factors [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 273, 1966.

5332 **Smith, James H.** A summary of stratigraphy and paleontology, upper Colorado and Montanan Groups, southcentral Wyoming, northeastern Utah, and northwestern Colorado, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 13–26, illus., 1965.

The general lithologic character and changing facies patterns of post–Carlile Late Cretaceous formations are discussed, some units are further subdivided and the new members named and described. New faunal data are presented which permit fairly precise regional correlation. A diagrammatic cross section showing correlations, and three measured sections accompany the paper.—E.S.L.

5080 **Smith, John Ward; Stanfield, Kenneth E.** Oil shales of the Green River Formation in Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 167–170, illus., 1965.

Wyoming's oil shale is estimated to represent 370 billion bbl of oil in place, and the primary reason it receives only token interest is because of the lack of detailed and valid oil-yield data. The origin of the Green River oil shales in Lake Gosiute is described, and distribution and sampling problems discussed. The limited oil-yield data available is evaluated.—E.S.L.

Smith, Robert L. *See* Friedman, Irving. 5310

Smithson, B. B. *See* Andrews, J. T. 5037

5323 **Smoor, Peter Bernard.** Dimensional grain orientation studies of turbidite graywackes [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 449, 1965.

5179 **Snavely, Parke D., Jr.; Wagner, Holly C.; MacLeod, Norman S.** Rhythmic-bedded eugeosynclinal deposits of the Tyee Formation, Oregon Coast Range, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 461–480, illus., table, 1964 [1966].

The middle Eocene Tyee Formation, a thick repetitious sequence of graded sandstone and siltstone, has a wide distribution. Studies indicate the sandstone is rather uniform in composition, and montmorillonite predominates in the siltstone. Analysis of over 500 directional readings on sole markings indicates that the sediments were laid down by turbidity currents flowing northward along the axis of a eugeosyncline. The source area is believed to have been in the ancestral Klamath Mts. Active volcanism east of the geosyncline also contributed debris. The streams draining these two source areas may have built large deltas in the southern part of the geosyncline and periodic slumping sent the turbidity currents over 150 mi along the axis.—E.S.L.

5389 **Soliman, Soliman M.** Geology of the east half of the Mount Hamilton quadrangle, California: California Div. Mines and Geology Bull. 185, 32 p., illus., tables, geol. map, 1965.

In the Isabel–Eylar area in the rugged Diablo Range, the Franciscan Formation, covered in only a few small patches by Tertiary basalt and Quaternary gravels, has two principal stratigraphic divisions: the lower consists of alternating thin beds of fine sandstone, siltstone, and shale, with small lenses of coarse sandstone, glaucophanite, greenstone and chert in upper part complicated by small structures due to slumping and tectonic deformation; the upper unit is massive graywacke

with lenses of greenstone and conglomerate near its base and of conglomerate and chert throughout. The formation was deposited by turbidity currents in a trough along the continental margin and the provenance appears to be rocks of the Klamath and Santa Lucia Mountains. Broad open folds trend northwest; many lines of faulting can be recognized but not easily traced.—G.D.C.

Solsona, Juan B. *See* Furrazola-Bermudez, Gustavo. 5338

5386 **Sørensen, Henning.** På spor af sjaeldne metaller i Sydgrønland—[Pt.] 2, Gardar rift-systemet [with English abs.]: Grønland 1966, no. 5, p. 163–176, illus., 1966.

The Precambrian Gardar rift was formed 1,500–1,000 m.y. ago and was the site of extensive volcanic activity. A thickness of about 1,500 m of volcanic rocks is now preserved in the rift zone. Basalts predominate; it has not been possible to demonstrate presence of alkali basalts, possibly because of later alteration of lavas in connection with emplacement of a number of intrusions. These are Igaliko (syenite and nepheline syenite), Ilimaussaq (syenite, nepheline syenite, paralkaline nepheline syenite and alkaligranite), Grønnedal-Ika (nepheline syenite and carbonatite), Kûngnât (gabbro, syenite and alkaligranite), Nunarssuit (gabbro, syenite, granite and alkaligranite), Ivigtut (granite and cryolite), and Tugtutôq (gabbro, syenite, nepheline syenite and alkaligranite). Magmatic evolution is discussed briefly.—*from* Author's abstract

5242 **Southwick, David L.** Petrography, chemistry, and possible correlations of the Camas Land sill and Teanaway dike swarm, central Washington: Northwest Sci., v. 40, no. 1, p. 1–16, illus., tables, 1966.

On the basis of more detailed mapping in northern Mount Stuart quadrangle and southern Chiwaukum quadrangle, an attempt is made to clarify the relations among four basaltic rock units of Tertiary age named by G. O. Smith (1904) in his reconnaissance of Mount Stuart quadrangle. The mapped area includes the "Eocene Gabbro" and part of the Teanaway dike swarm. New petrographic and chemical data on these units are presented, and relations of the intrusive Camas Land Diabase to the Teanaway and Yakima lavas are postulated on the basis of that evidence.—G.D.C.

5138 **Spaeth, M. G.; Berkman, S. C.** The tsunami of March 28, 1964, as recorded at tide stations: Rockville, Md., U.S. Coast and Geodetic Survey, 59 p., illus., tables, 1965.

The tsunami following the Alaskan earthquake of March 28, 1964, was the first on record to have been generated by an earthquake of such magnitude (8.5) with a continental epicenter, although small local tsunamis are known to have been generated by earthquakes of continental epicenters. Another notable feature was the seiche action set up in the Gulf of Mexico and many lakes in the United States. Tabulated data include tide gage records of the United States, Central America, South America, and many Pacific Islands; wave travel (great circle distance, time, average speed); and maximum recorded rise or fall. Tide gage records are illustrated graphically, and photographs are included of some of the damaged areas.—V.S.N.

5095 **Spalvins, K.** Recent arkosic alluvium at Mt. Arabia, Dekalb County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 75, 1966.

5187 **Speidel, David H.; Nafziger, Ralph H.** Retrograde melting in the system Mg-Fe-Si-O: Science, v. 152, no. 3727, p. 1367–1368, illus., 1966.

Under certain limits of oxygen fugacity and temperature in the system Mg-Fe-Si-O the crystalline assemblage of olivine, tridymite, and metallic iron will produce liquid with cooling. Changes in composition, accompanying changes in temperature, of the olivine phase cause exothermic oxidation of the metallic iron, providing enough heat to produce liquid.—Authors' abstract

5321 **Spieker, Edmund M.** The nature of geology and its place among the natural sciences: New York Acad. Sci. Trans., ser. 2, v. 28, no. 2, p. 159–169, 1965.

Geology is a comprehensive science, a genuine study of the Earth, offering a difficult domain of intellectual endeavor beneath its glamorous exterior. Science is largely conceptual; geology is possibly the most precarious as to control of fact and generalization by pattern of thinking. Geology qualifies as a basic science that covers a major area of natural phenomena, has a distinctive discipline, and is central to a number of dependent or organically related subjects. Most of its generalizations are local or regional in scope, which may or may not be well demonstrated or may be seriously questioned, and its problems are complex. The facts must be soundly determined, accurately recorded, mapped in the field, then analyzed. Deductive analysis is difficult because of hosts of variables; the effective use of mathematics lies almost entirely in the realms of geophysics or geochemistry.—G.D.C.

5349 **Springer, G. D.; MacDonald, W. D.; Crockford, M. B. B.** Jurassic, Chap. 10 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 137–155, illus., geol. maps, 1966.

Jurassic deposits in the Western Cordillera are of geosynclinal proportions but in the Eastern Cordillera and Interior Plains are only thin shelf deposits. A volcanic island belt was active along the west coast through Middle Jurassic time and up to 20,000 feet of volcanic and marine sedimentary rocks were accumulated in the Western Cordilleran eugeosyncline. With the end of volcanism in Late Jurassic time, up to 20,000 feet of marine to non-marine sediments, partly Cretaceous, were deposited. During the Nevadan orogenic uplift and granitic intrusion, the Late Jurassic sea transgressed from the north into the Eastern Cordilleran and Plains regions, fluctuated briefly, and then retreated. In the Williston basin Early red beds and Middle age evaporites and marine sediments were flooded by continental sediments from the western uplift, while marine conditions lingered in the north. Isopach and lithofacies maps are shown and various localities are described in an appendix.—G.D.C.

5050 **Spurgeon, Ernest S.** The Gasport Dolomite in the vicinity of Hamilton, Ontario [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 448, 1965.

Stanfield, Kenneth E. *See* Smith, John Ward. 5080

5090 **Stanley, Edward A.; Duncan, Wilbur H.; Montgomery, Florence.** Paleobotanical investigation of a lower Tertiary clay from northwestern Georgia [abs.]: Georgia Acad. Sci. Bull., v. 24, no. 2, p. 57–58, 1966.

5007 **Stanley, Kirk W.; Grey, Howard J.** Spray-on paint stripes to determine the direction of beach drifting: Jour. Geology, v. 74, no. 3, p. 357–361, illus., 1966.

Spray-on colored paint stripes, 8 inches wide, were used to determine direction of particle movement along the gravel and shingle beach of Homer Spit, Alaska. Stripes 40–80 feet apart and perpendicular to the waterline were used to determine lateral movement, and a stripe at mid-tide level and parallel to the waterline was used to determine movement up and down the beach face. After application, stripes were mapped and color photos taken. Observations were made over a 5-day period, and after each tidal change the locations of individual particles were plotted. The method offers an inexpensive way to study short-term movement of beach material.—V.E.S.

5362 **Staplin, Frank L.; Jansonius, Jan; Pocock, Stanley A. J.** Evaluation of some acritarchous hystrichosphere genera: Neues Jahrb. Geologie u. Paläontologie Abh., v. 123, no. 2, p. 167–201, illus., 1965.

Morphology and nomenclature of leiospheres (Leiosphaeritae) and simple hystrichospheres are reviewed. The subgroup Acanthomorphitae is restricted, Netromorphitae expanded, and Baltisphaeritae and Tasmanititae proposed. Fifteen form genera are diagnosed, including eight new. It is contended that the method of opening to release the cell contents in propagation is often distinct for suprageneric taxa, contrary to Eisenack's (1962) statement that circular openings (pyloms) are expected in all species. Diagnoses of form genera are based on structural characteristics, revealed by detailed study of morphology, rather than on

size or gross morphology. The genera are grouped by the system of Downie et al. (1963) for the group Acritarcha (excluding dinoflagellates).—V.M.J.

5326 **Steiner, J.** Lower Miette rocks at Jasper, Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 453, 1965.

Stephenson, D. A. *See* Gaines, A. M. 4987

Stephenson, Neville. *See* Papike, J. J. 4992

5379 **Stewart, R. E.; Newton, V. C., Jr.** (compilers). Oil and gas exploration in Oregon: Oregon Dept. Geology and Mineral Industries Misc. Paper 6, 41 p., illus., tables, revised 1965; originally published 1954.

Geologic data obtained by deep drilling in Oregon over the past 15 years indicate that the western Tertiary marine basin, the central Mesozoic marine basin, and the eastern Tertiary lake basin may still yield commercial quantities of oil and gas. The report includes well data, tables of gas and water analyses, a bibliography, and a map showing oil and gas drilling in the State in 1965.—M.C.M.

5257 **Stone, D. S.** Geologic and economic evaluation of the Laramie–eastern Hanna Basin area, Wyoming: Mtn. Geologist, v. 3, no. 2, p. 55–73, illus., tables, 1966.

The Laramie–eastern Hanna Basin area has a proved reserve of oil and oil equivalent of some 77 million bbls. Over 70 percent of this oil will come from Lower Cretaceous reservoirs, the rest from Jurassic and Carboniferous rocks. Primary stratigraphic entrapment in the Muddy, Dakota, and First Sundance Sandstones, followed by later adjustment to Laramide structure and redistribution through fractures and faults probably explains the accumulation of oil in the non-marine Lakota and Second Sundance Sandstones and in the Tensleep at Big Medicine Bow. Tensleep accumulation in the southern Laramie Basin may be related to early structural growth along northeast-trending right-lateral shear zones in the basement. Stratigraphic exploration for Mesozoic sandstone objectives in this area should be rewarded with moderate success in the future.—Author's abstract

5031 **Strahler, Arthur N.** Tidal cycle of changes in an equilibrium beach, Sandy Hook, New Jersey: Jour. Geology, v. 74, no. 3, p. 247–268, illus., 1966.

Profile surveys were made in the summers of 1959, 1960, and 1961 on the Atlantic beach near Sandy Hook, N. J. During early and middle summer a berm was built and the foreshore experienced accretion. By late July accretion ceased, yielding profile equilibrium. During this late summer period rhythmic minor changes in beach profile occurred with the semidaily tidal cycle. A model cycle consists of a short depositional phase as the tide rises, then a scour phase followed by deposition of sand and pebbles. During falling tide the changes are repeated in reverse order, restoring the beach to its original condition.—A.T.M.

Straley, H. W., 3d. *See* Husted, John E. 5097

5131 **Stringham, Glen E.** Discussion of article "The hydraulic shape of sand particles" by Louis I. Briggs, David S. McCulloch and Frank Moser [1962]: Jour. Sed. Petrology, v. 36, no. 1, p. 271–272, illus., 1966.

The effect of particle shape alone on the Dynamic Shape Factor does not follow the contour line gradient, as stated [ibid., v. 32, no. 4, p. 645–646, 1962] but rather follows a negative sloping line of constant force on the coefficient of drag–Reynolds Number diagram.—R.A.C.

5079 **Stuart, William J., Jr.** Stratigraphy of the Green River Formation, west of the Rock Springs uplift, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 159–166, illus., 1965.

The results of a surface stratigraphic investigation of the Green River Formation and equivalent tongues of the Wasatch located along the east-northeast margin of

the Bridger basin are presented. Eight stratigraphic sections were measured, and accompany the report. Four members or tongues are described, and the geologic history given. Problems and nomenclature of the tongues of the Wasatch are discussed.—E.S.L.

5297 **Summers, W. K.** A preliminary report on New Mexico's geothermal energy resources: New Mexico Bur. Mines and Mineral Resources Circ. 80, 41 p., illus., tables, 1965.

Information available on geothermal energy and power in New Mexico is summarized. Data on the location and characteristics of warm and hot springs and wells and the sources of information are tabulated. Characteristics include available data on chemical analyses. A comprehensive bibliography lists published information on geothermal energy in New Mexico; selected references on geochemistry, thermal dynamics, and fluid mechanics of hot water and steam; and general references. Appendixes tabulate data on costs of drilling and exploration for steam sources. The brief text discusses general information on sources of heat, geologic occurrence of steam, prospecting in New Mexico, geohydraulics, problems, and recommendations.—V.S.N.

5029 **Sutton, Robert G.; Lewis, Thomas L.** Regional patterns of cross-laminae and convolutions in a single bed: Jour. Sed. Petrology, v. 36, no. 1, p. 225–229, illus., 1966.

The Upper Devonian Bluff Point Siltstone in the Keuka Lake area of New York State has depositional structure orientations which suggest paleocurrent directions towards the west-northwest. The rocks are characteristically siltstones and shales with cross-laminae and convoluted bedding structures which apparently formed during deposition. Convolution axes and dip directions of cross-laminae show almost parallel orientation. The unit lacks the characteristics of a turbidite.—R.A.C.

5370 **Swartz, Frank M.** Guide to the Horse Shoe Curve section between Altoona and Gallitzin, central Pennsylvania: Pennsylvania Geol. Survey Bull. G 50 (Gen. Geology Rept.), 56 p., illus., table, 1965.

One of the finest displays of later Paleozoic strata to be found along the course of the Allegheny Front is exposed along the main line of the Pennsylvania Railroad in Blair County west of Altoona. In a distance of 45,000 feet are found approximately 7,000 feet of shales and sandstones from the base of the Pennsylvanian Conemaugh Group on the west to the base of the Upper Devonian Chemung Shale on the east. On the nearby roads the succession continues downward for another 1,800 feet to the Burket Black Shale at the Middle Devonian boundary. Descriptions as here given follow closely that presented in a guide leaflet (Swartz, 1946) for a trip of the 12th Annual Field Conference of Pennsylvania Geologists; parts of discussions are modified to consider subsequent investigations.—G.D.C.

Takeda, H. *See* Ross, M. 4999

Takeuchi, Y. *See* Wuensch, B. J. 5003

5399 **Tasch, Paul.** Periodicity in the Wellington Formation of Kansas and Oklahoma, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 481–496, illus., tables, 1964 [1966].

The Permian Wellington Formation is a shale sequence about 700 feet thick, with recurring thin limestone units, generally viewed as being deposited in epeiric seas. There is considerable evidence for alternation from limited evaporative conditions, to brackish, to fresh. A large-scale periodicity is the recently discovered recurrence of insect beds at 100-ft intervals; conchostracan-bearing beds represent the most persistent periodicity. These beds make possible the deciphering of a microscale periodicity, which permits interpretations of paleolimnological events on a season-by-season basis. The large-scale, small scale, and micro-scale periodicities are part of a paleolimnological cycle, here designated; two phases are discussed. It is possible that the paleolimnological cycle is the more productive approach to this type of study.—E.S.L.

5315 **Taubeneck, William H.** An evaluation of tectonic rotation in the Pacific Northwest: Jour. Geophys. Research, v. 71, no. 8, p. 2113–2120, illus., 1966.

The name "Columbia Arc" is proposed for the arcuate portion of the Nevadan orogenic belt in Oregon, Idaho, and Washington. Absence of distortion throughout a gigantic swarm of basalt dikes is a cardinal argument against paleomagnetic interpretations of post–Miocene tectonic rotation of the Columbia Arc. Other arguments are the undeformed Blue Mountain Front, undisturbed alinement of Cascade volcanoes, and lack of disruption of a zone of Pliocene faults. The Olympic–Wallowa lineament near the Oregon–Idaho boundary appears to have been tectonically inactive during the Mesozoic. A primary origin for the configuration of the Columbia Arc is preferred.—D.B.V.

Taxer, Karlheinz. *See* Buerger, Martin K. 5390

5020 **Taylor, R. Spence; Mathews, W. H.; Kupsch, W. O.** Tertiary, Chap. 13 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 190–194, illus., geol. map, 1966.

Except for a small area in the Interior Plains and some small coastal basins, Tertiary rocks of western Canada are of continental origin. Paleocene sedimentation was interrupted by orogenic and epeirogenic uplift, followed by intense erosion of the deformed Rocky Mountains and eastern flanks. Late Eocene and Oligocene streams deposited coarse gravels far into Saskatchewan, only remnants of which remain. No igneous activity or marked metamorphism occurred in the Rocky Mountains despite intense folding and faulting; later minor intrusions are found in the Sweetgrass Arch. In Yukon and interior British Columbia, volcanic and sedimentary rocks, mostly of Eocene and late Miocene or early Pliocene age, enclose coal, lava flows, and pyroclastics. In coastal British Columbia, Tertiary sedimentary rocks are of Eocene to Miocene age; volcanic rocks Paleocene(?) and Eocene. Tertiary distribution is shown on an isopach and lithologic map.—G.D.C.

5053 **Tedrick, R. L.** Ordovician geology of the Prophet River map-area, British Columbia [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 454, 1965.

5148 **Thomas, William A.** The Ouachita influence on Mississippian facies in Alabama [abs.]: Alabama Acad. Sci. Jour., v. 36, no. 4, p. 179–180, 1965.

5393 **Thompson, Gerald L.** Ground-water resources of Lee County, Texas: Texas Water Devel. Board Rept. 20, 131 p., illus., tables, 1966.

The sedimentary section in Lee County consists of about 6,000 feet of alternating beds of sandstone, silt, siltstone, clay, shale, and some thin local limestone lenses. Principal aquifers are the Eocene Simsboro Sand Member, and Carrizo, Queen City, and Sparta Sands. All aquifers except surficial deposits and in faulted areas dip southeastward at a rate of about 100–200 feet per mile. An intricate fault system (Mexia–Talco) trends northeastward and greatly complicates the geologic structure. About 21 percent of the water used annually issues from uncontrolled flowing wells. All principal aquifers possess water suitable for most uses. Estimated perennial yield of the practically untapped aquifers ranges from 12 to 40 mgd.—*from* Author's abstract

5083 **Thompson, Robert Wayne.** Tidal flat sedimentation on the Colorado River delta, northwestern Gulf of California [abs.], *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 188–189, illus., 1965.

Thurber, David L. *See* Richards, Horace G. 5387

Tilton, G. R. *See* Wetherill, G. W. 5364

Tisdall, W. H. *See* Macauley, G. 5017

5088 **Toots, Heinrich.** Orientation and distribution of fossils as environmental indicators, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs

uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 219–229, illus., tables, 1965.

The distribution and orientation of fossils varies from formation to formation, and even from one bed to another. These variations reflect processes of various kinds, so are valuable environmental and paleogeographic evidence. The discussions cover observation and description of facts, common types of preferred orientation, and distribution. Examples are taken from Wyoming Cretaceous and Tertiary rocks.—E.S.L.

Trautz, Otto R. *See* Zapanta-LeGeros, Racquel. 5328

Treiman, S. B. *See* Lewis, H. W. 5303

Troxel, Bennie W. *See* Wright, Lauren A. 5191

5052 **Turek, A.** Geology of Lake Cinch Mines Limited, Uranium City, Saskatchewan [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 454, 1965.

Unfer, Louis, Jr. *See* Raasch, Gilbert O. 5342

5228 **Ungnade, Herbert E.** Guide to New Mexico mountains: Denver, Colo., Sage Books, 232 p., illus., 1965.

The geologic history and mineral resources of New Mexico, and of each range, are reviewed briefly. The greater part of the book is a climbing guide. Maps and photographs illustrate the text.—E.S.L.

5241 **United Nations.** Proceedings of the Third International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1964, V. 16—List of papers and indexes [with French, Russian, and Spanish explanatory notes]: New York, United Nations, 128 p., 1965.

The present volume comprises: a numerical index of papers contained in the first fifteen volumes of proceedings of this conference, plus author index, index of speakers at discussions, subject index, index of papers by submitting country or organization, and contents of proceedings. Detailed explanations for each of these indexes are given in the four official languages of the conference.—G.D.C.

5120 **U.S. Coast and Geodetic Survey.** (compiler). The magnetic inclination or dip, epoch 1965.0—North polar area, H.O. 1700N (3d edition): Washington, D. C., U.S. Naval Oceanog. Office, scale 1:10,000,000, 1965.

5121 **U.S. Coast and Geodetic Survey.** (compiler). The horizontal intensity of the Earth's magnetic force, expressed in centimeters-grams-second units, epoch 1965.0—North polar area, H.O. 1701N (3d edition): Washington, D. C., U.S. Naval Oceanog. Office, scale 1:10,000,000, 1965.

5122 **U.S. Coast and Geodetic Survey.** (compiler). The vertical intensity of the Earth's magnetic force, expressed in centimeter-gram-second units, epoch 1965.0—North polar area, H.O. 1702N (3d edition): Washington, D. C., U.S. Naval Oceanog. Office, scale 1:10,000,000, 1965.

5123 **U.S. Coast and Geodetic Survey.** (compiler). The total intensity of the Earth's magnetic force expressed in centimeter-gram-second units, epoch 1965.0—North polar area, H.O. 1703N (3d edition): Washington, D. C., U.S. Naval Oceanog. Office, scale 1:10,000,000, 1965.

5124 **U.S. Coast and Geodetic Survey.** (compiler). Magnetic grid variation, epoch 1965.0—North polar area, H.O. 1706NG (4th edition): Washington, D. C., U.S. Naval Oceanog. Office, scale 1:10,000,000, 1965.

5334 **U.S. Coast and Geodetic Survey.** (compiler). Magnetic variation, epoch 1965.0—H.O. 1706 (5th edition): Washington, D. C., U.S. Naval Oceanog. Office, scale 1:39,000,000, 1965.

5335 **U.S. Coast and Geodetic Survey.** (compiler). Magnetic variation, epoch 1965.0—North polar area, H.O. 1706-N (5th edition): Washington, D. C., U.S. Naval Oceanog. Office, scale 1:10,000,000, 1965.

5230 **Utting, J.** Newfoundland—Its history and Carboniferous geology: Sheffield Univ. Geol. Soc. Jour., v. 5, no. 3, p. 6–9, illus., 1966.

Studies made in the Codroy Valley are reported. Two Mississippian groups, a transition formation, and a Pennsylvanian group are described briefly. A geologic sketch map and section accompany the paper.—E.S.L.

5030 **Vaasjoki, O.** On basalt rocks with native iron in Disko, West Greenland: Finlande Comm. Geol. Bull., no. 218, p. 85–97, illus., table, 1965.

The tholeiitic basalt series of Disko, Greenland, is accompanied by an anorthositic component and by native iron which probably mean that exceptional conditions prevailed during eruption of basalts both in near surface and deep zones. The basalt previously has been described as an enstatite basalt and, on the basis of a chemical composition given here, this is probably correct. Ore minerals—pyrrhotite, chalcopyrite, native iron and some magnetite—occur sparsely. Inclusions in Asuk samples are plagioclase with reddish spinel, iddingsite pseudomorphs after olivine, glass, and ore. Processes are outlined for formation of an enstatite basalt with essential amounts of magnetite, and it is proposed that the magnetite was reduced by coal substances incorporated from sedimentary beds to produce the native iron; moreover, hydrous and sulfide materials from the sediments probably gave rise to sulfide-bearing phases of hydrothermal character.—V.S.N.

5266 **Valencia, Josefina; Fries, Carl, Jr.** Contribuciones del Laboratorio de Geocronometria—Pt. 3, Compendio de edades de radiocarbono de muestras mexicanas de 1962 a 1964: Mexico Univ. Nac. Autonoma Inst. Geologia Bol. 73, p. 135–191, table, 1965.

Since the publication of Boletin 64 of this series in 1962, 127 additional age samples have been collected from Baja California to Yucatan, including some dredged from the sea bottom off the coasts of Mexico. These are tabulated here together with brief descriptions of the samples and discussions of significance of the results. All dates will be published in *Radiocarbon*.—M.C.M.

VandeGraaff, Fred. *See* Hale, L. A. 5333

5347 **vanHees, Hendrik; North, F. K.** Cambrian, Chap. 3 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 20–33, illus., geol. map, 1966.

In the sedimentary basin of the Plains region only Middle and Upper deposits of a slowly eastward transgressing Cambrian sea are present. Beyond the well preserved Middle Cambrian shoreline in Saskatchewan, the Upper Cambrian, truncated by Ordovician and Devonian unconformities, rests on Precambrian basement. Marked gases have been found in Upper strata over Precambrian anomalies, and in localized sand lenses of diachronous basal beds. Cambrian rocks of the Cordillera crop out in a belt bisected by the Rocky Mountain Trench, everywhere underlain by Proterozoic sediments. The facies become increasingly carbonate upwards through the entire series to the final argillaceous phase. All trilobite zones of the western Cambrian are represented, truncated eastward by the Devonian unconformity. Lithologic correlation sections are included.—G.D.C.

5180 **VanHouten, Franklyn B.** Cyclic lacustrine sedimentation, Upper Triassic Lockatong Formation, central New Jersey and adjacent Pennsylvania, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 497–531, illus., tablę, 1964 [1966].

The Lockatong lacustrine deposits are arranged in short asymetrical detrital and chemical cycles. Detrital short cycles comprise black shale, carbonate-rich mudstone, and gray massive calcareous mudstone with a contorted fabric. More

common chemical short cycles have lower beds of alternating dark-gray to black dolomite-rich mudstone and marlstone, middle bed of dark-gray mudstone enclosing layers of gray marlstone disrupted by syneresis, and upper part of gray massive analcime- and carbonate-rich mudstone disrupted by syneresis and shrinkage cracks. Varve counts suggest that short cycles resulted from 21,000-year precession cycles. Bundles of short cycles occur in intermediate cycles 70-90 feet thick, and these occur in long cycles 325-350 feet thick. The patterns apparently resulted from alternating wetter and drier phases of intermediate and long climatic cycles.—E.S.L.

5181 **VanSiclen, D. C.** Depositional topography in relation to cyclic sedimentation, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 533-539, illus., 1964 [1966].

The electric logs of numerous wells drilled in western Texas afford an opportunity for detailed stratigraphic studies, which disclose that the sediments deposited during the regressive part of the major Pennsylvanian-Permian cycle assumed a topographic form resembling the classic delta, with topset, foreset, and bottomset segments in sequence toward the southwest. True stability was rarely attained because relative sea level often changed. During transgression, limestone accumulated along the outer undaform, occasionally developing a barrier reef. Normal conditions would be restored, or regression might cause deposition of coal, red clay, or evaporites, or erosion and channelling might take place. More commonly incomplete or composite cycles resulted.—E.S.L.

5218 **Veeh, Hans Herbert.** Thorium-230/uranium-238 and uranium-234/uranium-238 ages of elevated Pleistocene coral reefs and their geological implications [abs.]: Dissert. Abs., v. 26, no. 9, p. 5373-5374, 1966.

5229 **Verma, Ajit Ram; Krishna, P.** Polymorphism and polytypism in crystals: New York, John Wiley and Sons, 341 p., illus., tables, 1966.

The phenomenon of polytypism is described in relation to polymorphism, crystal growth, and dislocations. Various theoretical explanations, as well as the recent experimental investigations by X-ray diffraction, phase-contrast microscopy, and multiple-beam interferometry, phase and structural aspects of polymorphism, and the one-dimensional form are discussed.—E.S.L.

VerPlanck, William E. *See* Bowen, Oliver E., Jr. 5398

Vlisidis, Angelina C. *See* Mrose, Mary E. 5325

5201 **Vogel, B. R.; Durden, C. J.** The occurrence of stigmata in a Carboniferous scorpion: Jour. Paleontology, v. 40, no. 3, p. 655-658, illus., 1966.

A recent examination of *Palaeopisthacanthus schucherti* Petrunkevitch revealed the presence of stigmata and lateral eyes, and the absence of any postabdomen in the available material. A new diagnosis of the genus and diagnosis and description of the species are given.—Authors' abstract

5182 **Waage, Karl M.** Origin of repeated fossiliferous concretion layers in the Fox Hills Formation, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 541-563, illus., 1964 [1966].

Successive layers of fossiliferous concretions dominated by great numbers of one or two molluscan species characterize marine parts of the Late Cretaceous Fox Hills Formation in north-central South Dakota. Individual fossil assemblages appear to have formed simultaneously throughout their extent, the more widespread covering at least 1,500 sq mi and containing millions of specimens of the dominant species. The assemblages occupied northeast-trending areas in a northern embayment of the waning interior sea. Groups of assemblages show progressive southward shift with encroachment of littoral facies. Distribution patterns, with the dominance of a few species, bear a marked resemblance to modern marine bottom communities. Indications are that the assemblages resulted from recurrent mass mortalities.—E.S.L.

Wagner, Holly C. *See* Snavely, Parke D., Jr. 5179

5183 **Wagner, Holly C.** Pennsylvanian megacyclothems of Wilson County, Kansas, and speculations concerning their depositional environments, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 565–591, illus., 1964 [1966].

Cyclothems recorded in these rocks are parts of six megacyclothems whose characteristic environments resulted in the formation of rocks with clearly different lithologic and faunal attributes. Ten depositional stages composing each megacycle are categorized and described, and speculations concerning their depositional environments are given.—E.S.L.

Wahlstedt, Warren J. *See* Gerhard, Lee C. 5419

5348 **Walasko, J. T.** Petrology of a Permo-Carboniferous section in northern Jasper National Park [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 455, 1965.

5368 **Wald, George.** The origins of life, *in* The scientific endeavor—Centennial celebration of the National Academy of Sciences (1963): New York, Rockefeller Inst. Press, p. 113–134, illus., tables, 1965.

If algae and photosynthesis existed at least 1.6 b.y. ago, as indicated by the Gunflint Iron Formation, Ontario, more primitive life must be considerably older. Simple gases in an atmosphere lacking oxygen reacted to form organic molecules which accumulated in the seas and became more complex. With decline of hydrogen pressure, organic syntheses were completed and unstable ammonia and methane replaced by nitrogen and carbon dioxide. In evolution of energy metabolism, fermentation occurred, then a hexosemonophosphate cycle, photophosphorylation, and photosynthesis, all in an anaerobic phase, and respiration in an aerobic phase. Carbon, nitrogen, oxygen, and hydrogen played basic roles. Waters of ancient seas set the pattern of ions in our blood; ancient atmosphere molded our metabolism.—G.D.C.

5117 **Wallin, Helen.** Biographical sketch of Douglass Houghton [1809–1846]—Michigan's first State Geologist, 1837–1845: Michigan Geol. Survey Pamph. 1, 17 p., portrait, 1966.

Wang, Cheh-Cheng. *See* Goldsmith, Werner. 5312

5184 **Wanless, Harold R.** Local and regional factors in Pennsylvanian cyclic sedimentation, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 593–606, illus., 1964 [1966].

Emphasis in the interpretation of Pennsylvanian cyclothems has been placed largely on repetition of rather complex successions. Here it is noted that these uniform sequences may be interrupted at any stratigraphic position by clastic wedges thickening in the direction of the source. Environmental maps of the Midwest area indicate that within a single widespread cyclothem, clastic wedges may reach the sedimentary basin from three or four different directions. Their stratigraphic positions and directions of source of sediment provide excellent clues to the time and place of contemporary tectonism. It is proposed that the megacyclothem of the northern Midcontinent is equivalent to a single cyclothem of the Illinois basin type, rather than a number of these as has been suggested.—E.S.L.

5219 **Warnke, Detlef Andreas.** A geologic study of the Halloran Hills, central Mojave Desert, California [abs.]: Dissert. Abs., v. 26, no. 9, p. 5374, 1966.

5115 **Watkins, J. S.; Yuval, Zvi.** Simple Bouguer gravity map of the Mount Pleasant, Albemarle, Denton, and Salisbury quadrangles, west-central North Carolina: U.S. Geol. Survey Geophys. Inv. Map GP-582, scale 1:62,500, 1966.

5047 **Watts, Terence Roger.** Grain size variations in the beach sands of Long Point, Lake Erie [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 449–450, 1965.

Waugh, Wanda N. *See* Galle, O. Karmie. 5243

5023 **Webb, J. B.** Historical summary, Chap. 16 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 218–232, illus., geol. maps, 1966.

Beneath the Plains and the Cordillera of western Canada the stratigraphic record is fairly complete from Proterozoic to Quaternary time, but important gaps represent intervals of epeirogenic uplift and erosion. This chapter reviews the information and conclusions of the detailed contributions to this atlas. A number of maps show distribution of the chief sequences so far as they are preserved. The stratigraphy and depositional history of each period or epoch are summarized; the Cordilleran orogenies and cratonic sequences are given on a chart.—G.D.C.

5041 **Weber, Jon N.; Williams, Eugene G.** Environmental classification of argillaceous sedimentary rocks using the chemical composition of siderite nodules: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 432–440, illus., tables, 1965.

In the search for geochemical indicators, 45 syngenetic siderite nodules from Pennsylvanian shales were assigned to categories on the basis of associated freshwater, brackish, and marine fossils. Of 11 elements determined in the nodules, Si, Al, Mg, Ca, Ba, and V are useful as environmental discriminators; means and standard deviations for these are given. A three-group, six-variable discriminant function permits complete separation of individual freshwater and marine samples, but is less successful in distinguishing the brackish shales as a separate category. Siderites formed during sedimentation may prove especially useful for environmental discrimination where variations in the detrital to authigenic clay mineral ratio diminish the value of trace element indicators in the argillaceous fraction of the rock.—*from* Authors' abstract

5048 **Weber, Jon N.** The geochemistry of some graywackes and some shales [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 448–449, 1965.

Weimer, Robert J. *See* Hoyt, John H. 5086

5128 **Weimer, Robert J.** Stratigraphy and petroleum occurrences, Almond and Lewis Formations (Upper Cretaceous), Wamsutter Arch, Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 65–80, illus., table, 1965.

The facies changes in the four time-stratigraphic intervals of the intertonguing Almond and Lewis Formations are described, and the geologic history of the area is related to shoreline movements along the western margin of the Lewis Sea. Most production from this section of the Cretaceous is natural gas, but the large Patrick Draw oil field produces from the Almond Formation. Isopach maps and sections illustrate the time-stratigraphic intervals.—E.S.L.

5373 **Weitz, Joseph L.** Your future in geology: New York, Richards Rosen Press, 192 p., 1966.

Chapters in this book cover: why geology?; nature of geology; variety of Earth sciences and of geologic work; do you have what it takes?; background, training, and costs; geologic organizations; opportunities in geology, in government, industry, and education, and for women; salaries, fringe benefits, opportunities for advancement, and other careers geologists have found; first job, preparing and using a resume, common mistakes, and some tips; "disadvantages" of a career in geology; and geology is exciting and fun. Appendixes list institutions with degree-granting departments and major public sources of geological information; a selected bibliography is included.—M.C.M.

5220 **Weitz, Joseph Leonard.** Geology of the Bay of Islands area, western Newfoundland [abs.]: Dissert. Abs., v. 26, no. 9, p. 5374–5375, 1966.

5309 **Wermund, E. G.; Burke, W. H., Jr.; Kenny, G. S.** K–Ar ages of detrital muscovite in the Meridian Sand of Alabama and Mississippi: Geol. Soc. America Bull., v. 77, no. 3, p. 319–322, illus., tables, 1966.

The Eocene Meridian Sand of Mississippi and Alabama contains abundant large subhedral to anhedral flakes of muscovite (2M). K–Ar age determinations of the muscovite yield ages of 290±6 and 308±6 m.y. The Meridian muscovite is detrital and was probably derived from the Appalachian Mountains to the east.—Authors' abstract

5279 **Werth, Glenn; Randolph, Philip.** The Salmon seismic experiment: California Univ. Lawrence Radiation Lab. Rept. UCRL–14487 (Rev. 1), 14 p., illus., 1965.

The Salmon experiment observed nonlinear effect and generation and propagation of seismic waves from a tamped explosion in a salt dome in southeastern United States. Data are compared to theoretical calculations of decoupled explosions to obtain decoupling ratios and magnitudes of such explosions, and to propagation data from explosions in the western United States. Major conclusions suggest an upper mantle velocity of 8.3–8.5 kmps with M–discontinuity dipping 3° southward in Mississippi; P–waves out to 2,500 km have higher amplitudes, faster apparent velocities, and higher signal frequencies to the north and northeast than to the west; sharp velocity gradient increases at 140 and 330 km; a 1.5–sec modification to the Jeffrey–Bullen traveltime tables; and a revision in amplitude factors used in defining body–wave magnitude at small distances. Various cavity formation data are given.—V.S.N.

5388 **Wessels, Gerhardus J. M.** Groundwater studies by the electrical resistivity method in the Big Creek region of Ontario: Guelph Univ. School Agr. Eng., Eng. Tech. Pub. 12, 27 p., illus., tables, 1965.

The Big Creek region is an area of 610 sq mi north of Lake Erie in Norfolk, Brant, Haldimand, and Oxford Counties, Ontario, underlain for the greater part by the Delaware Formation (limestone). Vertical and horizontal electrical resistivity sounding surveys were made, using Schlumberger and Wenner configurations respectively, to evaluate ground–water resources and to test the application of the methods to such problems. The Schlumberger configuration technique was rapid and satisfactory, although in depth to bedrock interpretation with the Enslin method, electrode separation should be altered from a logarithmic to a geometric spread. Horizontal profiles were difficult to interpret. Curves, profiles, and their geologic interpretations are illustrated, and resistivity interpretation and drilling records are tabulated in appendixes.—V.S.N.

5364 **Wetherill, G. W.; Tilton, G. R.; Davis, G. L.; Hart, S. R.; Hopson, C. A.** Age measurements in the Maryland Piedmont: Jour. Geophys. Research, v. 71, no. 8, p. 2139–2155, illus., tables, 1966.

Rb–Sr, K–Ar, U–Pb, and Th–Pb ages of rocks and minerals from the Appalachian Piedmont near Baltimore, Md., and Washington, D.C., are reported. The oldest unit is the Baltimore gneiss (1,100 m.y.), which is overlain by the metasedimentary Glenarm Series. Late post–Glenarm pegmatites give Rb–Sr ages of 425±20 m.y. Other pegmatites give age values of about 345 m.y. Massive granitic rocks give ages similar to those of the older pegmatites. Most biotite (Rb–Sr and K–Ar) and hornblende (K–Ar) ages from the Paleozoic and some of the Precambrian rocks reflect an event 300 m.y. ago.—D.B.V.

5400 **Wheeler, Harry E.** Baselevel transit cycle, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 623–630, illus., 1964 [1966].

All stratigraphic "datum" points either coincide with or relate directly to the lithosphere surface at the time of their origin. At any moment, any point on the lithosphere surface may be undergoing either deposition or degradation, or may be in a condition of equilibrium (baselevel). . . . Consequent, area–time, stratigraphic patterns are cyclic, in which the depositional and hiatal phases alternate. Because the major baselevel transit cycles generally differ from the "insignificant" ones by several orders of magnitude, the fragmentary preserved record of the depositional

phases of these major cycles may be distinguished as unconformity-bounded sequences which serve as the stratigraphic basis for interpretation of the major episodes in geologic history.—Author's abstract

5189 **Whetten, John T.** Sediments from the lower Columbia River and origin of graywacke: Science, v. 152, no. 3725, p. 1055–1057, illus., 1966.

The mineral and chemical composition of sediments deposited in the three lowermost reservoirs of the Columbia River is remarkably similar to the composition of many graywackes. Lithic fragments are abundant. In comparison with an "average" sandstone, the sediments have low concentrations of silica and high concentrations of all other major constituents, except calcium. Sodium is more abundant than potassium. The sediments are generally better sorted than graywackes. If graywacke texture is post-depositional in origin, Columbia River-type sediments could be expected to form graywackes upon deep burial without any significant addition or removal of material.—Author's abstract

5304 **White, William A.** Drainage asymmetry and the Carolina capes: Geol. Soc. America Bull., v. 77, no. 3, p. 223–240, illus., 1966.

The drainage pattern of the Atlantic Coastal Plain of the Carolinas and southern Virginia is characterized by relatively straight extended consequent main streams with nearly all tributaries on the north sides. The asymmetric pattern is related to drainage divides formed by relict counterparts of present-day Cape Hatteras, Cape Lookout, Cape Fear, and Cape Romain. The capes first developed at the Fall Zone. Long narrow shoals, which extend offshore from capes, provided a base for the succession of capes that grew seaward during periods of shoreline emergence. North of the James River the major streams are repeatedly deflected southwestward as they cross the Coastal Plain, and at one time the Susquehanna River probably emptied into the head of the Hatteras Submarine Canyon.—D.H.W.

5002 **White, William B.** Determination of proton positions in crystals by infrared spectroscopy [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 275, 1966.

5322 **White, William B.; Keester, Kenneth L.** Optical absorption spectra of iron in the rock-forming silicates [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 275, 1966.

5078 **Wiegman, Ronald W.** Spring deposits—Surface expressions of the Henry's Fork fault, Sweetwater County, Wyoming, *in* Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—Wyoming Geol. Assoc., 19th Field Conf. 1965, Guidebook: Casper, Wyo., Petroleum Inf., p. 156–158, illus., 1965.

Irregular masses lying unconformably on the Green River Formation in Sweetwater County, Wyo., appear to trace an extension of the Henry's Fork fault system. Composed predominantly of dolomite and calcite with quartz veins and crystals, these masses probably were precipitated from spring water percolating upward along fractures developed above the fault.—*from* Author's abstract

5061 **Willard, Bradford.** Memorial to Dean Benjamin McLaughlin (1901–1965): Geol. Soc. America Bull., v. 77, no. 2, p. P23–P25, portrait, 1966.

5137 **Willey, Gordon R.** New World archaeology in 1965: Am. Philos. Soc. Proc., v. 110, no. 2, p. 140–145, 1966.

Recent literature on archeology in North and South America is reviewed under three topics: arrival of man in the New World, development of agriculture, and emergence of elements of civilization. Hypothetical dates of arrival range from shortly before 10,000 B.C. to 30,000 or 40,000 or more years ago, based on comparisons of Upper Paleolithic blades and projectile points of Siberia and Lower or Middle Paleolithic chopping tools of southeast Asia with American artifacts, in association with radiocarbon dates and geological contexts.—V.M.J.

Williams, Eugene G. *See* Weber, Jon N. 5041

5351 **Williams, Gordon D.; Burk, C. F., Jr.** Upper Cretaceous, Chap. 12 *in* Geological history of western Canada: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 169–189, illus., geol. map, 1966.

Upper Cretaceous rocks, at surface or beneath glacial drift, cover more than two-thirds of the western Canada sedimentary basin. Complete sections, where preserved by Tertiary cover, east of the Rocky Mountains grade vertically upwards from shallow marine to continental facies, superimposed by a similar lateral gradation from east to west. In the interior Cordillera a succession of coarse continental clastics and volcanics were deposited in intermontane basins. In the western Cordillera thick marine and continental deposits were laid, apparently by a late "Pacific" sea. Terrain west of the Rocky Mountain Trench was probably the source for clastic deposits along the western edge of the interior sea.—G.D.C.

5064 **Williams, M. Y.; Johnson, Helgi.** Memorial to Albert Orion Hayes (1882–1965): Geol. Soc. America Bull., v. 77, no. 3, p. P41–P47, portrait, 1966.

Williams, S. A. *See* Bideaux, R. A. 5068

Wilson, J. Robert *See* Billings, Marland P. 5336

5385 **Wilson, M. E.** The Precambrian of Canada—The Canadian Shield, *in* The geologic systems—The Precambrian, V. 2: New York, Interscience Publishers, p. 263–415, illus., tables, 1965.

The Canadian Shield is divided into five provinces—the St. Lawrence, Churchill, Ungava, Arctic Islands, and Greenland—and the history of geological investigations in the Shield is described under each. Some of the problems considered are: the basis for major rock group names; classification and correlation inferred from relations and radioactive dating; relation of early Precambrian volcanism to magmatic differentiation; metamorphism, including granitization; and Precambrian orogeny. Metallic and nonmetallic mineral deposits are discussed.—E.S.L.

5104 **Wolfe, John A.** The impact of new technology on geology and mining, *in* Minerals Day collected papers: Skokie, Ill., Internat. Minerals and Chem. Corp., Mining and Explor. Div., p. 16–37, illus., tables, 1965.

New technological developments are strongly influencing mineral economics in five important areas: automation by low-cost electrical power substituted for expensive manpower; discovery of tremendous new reserves of important mineral commodities; improved production methods and metallurgical techniques permitting mining of much lower grades of ore; discovery and appraisal of vast mineral resources in the oceans, available at economic to submarginal costs in such quantity that to move them onto the continent might upset isostatic equilibrium; and intersubstitution of one commodity for another. Two major problems in production from the ocean are the metallurgical separation of the elements in nodules, and economical dredging without overproduction of by-products.—G.D.C.

Wones, D. R. *See* Ross, M. 4999

Wood, Rhoda M. *See* Wood, William H. 5024

5024 **Wood, William H.; Wood, Rhoda M.** Arithmetic means of circular data: Jour. Sed. Petrology, v. 36, no. 1, p. 50–56, illus., 1966.

Direct algebraic determination of arithmetic means inherent in two-dimensional orientation data is demonstrated. Such means may be manipulated statistically in the same manner as the means of linear data. Means of circular data determined by a vector method are less sensitive to extreme values than arithmetic means. To avoid loss of geologically significant information, the computation of both means is recommended.—R.A.C.

5012 **Word, Darrell R.; Hopkins, George, Jr.; Patrick, Fred W.** Subsurface resistivity sounding in the Delaware Basin—Pt. 1, Operation and instrumentation [Contract

Nonr 375 (17)]: Texas Univ. Elec. Eng. Research Lab. Rept. 137, 22 p., illus., 1965.

Operational phases are described of a project to make and analyze measurements of both the natural magnetotelluric field and signals artificially induced in the vicinity of a known geologic structure, in this case the Delaware basin near Pecos, Tex. The instrumentation field layouts, and data acquisition techniques are described and illustrated in detail. No actual results other than a few sample data are given.—V.S.N.

5191 **Wright, Lauren A.; Troxel, Bennie W.** Strata of late Precambrian–Cambrian age, Death Valley region, California–Nevada: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 846–857, illus., 1966.

The Noonday Dolomite, Johnnie Formation, Stirling Quartzite, Wood Canyon Formation, and Zabriskie Quartzite of probable Late Precambrian–Cambrian age, are conformable and predominantly detrital. Correlations are facilitated by the regional persistence of most members, the distinctive lithologic character of the Noonday Dolomite, and the presence of two marker units—an oölite and a volcanic ash(?)—high in the Johnnie Formation. Isopachous contours appear to outline a north–northwest trending marine trough, and suggest that the Mojave block existed as a topographic high in late Precambrian–Cambrian time.—W.C.C.

5003 **Wuensch, B. J.; Takeuchi, Y.; Nowacki, W.** Comparison of the crystal structures of binnite, $Cu_{12}As_4S_{13}$, and tetrahedrite, $Cu_{12}Sb_4S_{13}$ [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 276, 1966.

Wyant, D. G. *See* Hawley, C. C. 5344

5384 **Wyoming Geological Association.** Sedimentation of Late Cretaceous and Tertiary outcrops, Rock Springs uplift—19th field conference, 1965, guidebook: Casper, Wyo., Petroleum Inf., 233 p., illus., tables, geol. map, 1965.

In this guidebook thirteen papers cover the stratigraphy, petrology, and paleontology of the Cretaceous, and seven cover the Tertiary. Recent sediments are discussed in three papers and four others cover subjects of general interest. An isometric diagram and six sections accompany the papers.—E.S.L.

5014 **Yacoub, Nazieh K.** Magnetic survey of the Jefferson area, Park County, Colorado: Mtn. Geologist, v. 2, no. 4, p. 193–201, illus., 1965.

The Jefferson anticline plunges south and extends approximately in a north–south direction, with its west limb cut by the Baker Lake porphyry and the east lying under the upper plate of the Elkhorn thrust fault. A magnetic survey of the area was made using the Varian magnetometer yielding 26 profiles spaced 700–1,000 feet apart. The magnetic beds form the basal part of the Denver Formation of Tertiary age.—M.C.

5221 **Yeend, Warren Ernest.** Quaternary geology of the Grand Mesa area, western Colorado [abs.]: Dissert. Abs., v. 26, no. 9, p. 5375–5376, 1966.

5240 **Yolton, James S.** Fossils of New Jersey: Geol. Soc. New Jersey Rept. 2, 46 p., illus., table, geol. map, 1965.

This book has been designed as a guide to those who wish to collect fossils in New Jersey; it is not a phamphlet on paleontology nor an all inclusive work on New Jersey fossils. The three dozen fossils illustrated are shown approximately natural size. In the absence of Oligocene deposits in New Jersey, the newer system of Paleogene and Neogene division of the Cenozoic is favored.—G.D.C.

5043 **Yorath, C. J.** Micropalaeontology of the Deer Bay Formation, Arctic Archipelago, Canada [abs.]: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 455, 1965.

5025 **Young, Edward J.** A critique of methods for comparing heavy mineral suites: Jour. Sed. Petrology, v. 36, no. 1, p. 57–65, 1966.

Five different methods of determining relative amounts of heavy minerals were evaluated using two splits of the same sand sample (F and F*) collected by Rittenhouse (1943) from the Rio Grande at Bosque, N. Mex. Relative deviations in percent computed for each set of results were used as the basis for comparison. Methods compared included: number percentage, weighted number percentage, weight percentage, hydraulic ratio, and mineral ratios. The total weighted number percentage method yielded the lowest percentage relative deviation.—R.A.C.

5354 **Young, H. R.** Heavy minerals from the Viking Formation, west central Alberta: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 397–404, illus., table, 1965.

A heavy mineral assemblage from the Viking Sandstone of west-central Alberta indicates that pre-existing sedimentary rocks were the major source of sediments. Igneous and metamorphic rocks also made some contribution.—Author's abstract

Yuval, Zvi. *See* Watkins, J. S. 5115

5004 **Zahrobsky, R.; Baur, Werner H.** The crystal structure of copper(II) sulfate trihydrate [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 276, 1966.

Zandle, G. L. *See* Boynton, G. R. 5234

Zandle, G. L. *See* Boynton, G. R. 5235

5328 **Zapanta-LeGeros, Racquel; LeGeros, John P.; Trautz, Otto R.; Klein, Edward.** X-ray diffraction studies on the problem of carbonate substitution in the apatite structure [abs.]: Am. Mineralogist, v. 51, nos. 1–2, p. 277, 1966.

5423 **Zarrella, William M.** Significance of hydrocarbon disposition in petroleum exploration [abs.]: Mtn. Geologist, v. 3, no. 2, p. 95, 1966.

5185 **Zeller, Edward J.** Cycles and psychology, *in* symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 2, p. 631–636, illus., 1964 [1966].

In an evaluation of our present techniques for dealing with complex stratigraphic successions, it is found that the Pennsylvanian presents problems which are, in part, related to the psychological make-up of the geologists. A test was devised to determine the extent to which psychological factors influenced geological thinking. A conventional log was given, along with sections made up from columns of digits taken from a random number table, to graduate students for correlation. Two- and three-component systems of cycles are discussed.—E.S.L.

Zimmer, E. *See* Colombo, U. 5145

INDEX

[The numbers refer to entries in the abstracts]

Absolute age, dates
Carbon–14
California and Oregon, Pleistocene marine shells: Richards, Horace G. 5387
Mexico, list, 1962–64, determinations: Valencia, Josefina. 5266
Oregon, Summer Lake, pumice: Allison, Ira S. 5311
Texas, charcoal in Sims Bayou: Slaughter, Bob H. 5382
Washington, shells, wood peat: Esterbrook, D. J. 5381
Coral reefs
Th–U and U–U, Pleistocene and recent: Veeh, Hans Herbert. 5218
Granitic rocks
California, Sierra Nevada, K–Ar: Kistler, R. W. 5302
Igneous rocks
Canada, western Cordillera, Upper Cretaceous: Williams, Gordon D. 5351
Maryland: Wetherill, G. W. 5364
Mexico, determinations since 1962: Fries, Carl, Jr. 5418
New Mexico, Valles Caldera, rhyolite: Doell, Richard R. 5401
Interpretation
Basic criteria, Maryland and Texas rocks: Baadsgaard, H. 5245
Canada, western, Precambrian time–rock units: Burwash, R. A. 5010
Metamorphic rocks
Canada, western Cordillera, Upper Cretaceous: Williams, Gordon D. 5351
Maryland: Wetherill, G. W. 5364
Mexico, determinations since 1962: Fries, Carl, Jr. 5418
Meteorites
Cosmic-ray exposure, argon isotopes: Cobb, James C. 5223
Minerals
Alberta, Jasper, Tekarra Creek map-area, muscovite: Steiner, J. 5326
Sedimentary rocks
Alabama–Mississippi, Meridian Sand, muscovite: Wermund, E. G. 5309
Pacific Ocean, deep-sea sediments: Dymond, Jack R. 5224
Thorium–uranium
California and Oregon, Pleistocene marine shells: Richards, Horace G. 5387

Absolute age, methods
General
Archeology, applications: Rainey, Froelich. 5136
Principles, methods, applications, review: Baadsgaard, H. 5245
Lead–alpha
Concepts and techniques: Rincon-Orta, Cesar. 5265
Potassium–argon
Deep-sea sediments: Dymond, Jack R. 5224

Alabama
Absolute age
Meridian Sand, muscovite: Wermund, E. G. 5309
Economic geology
Polymetallic ores, Cragford area: Neathery, Thornton L. 5149
Stratigraphy
Mississippian, Floyd–Parkwood sequence, northwestern, Ouachita influence: Thomas, William A. 5148
Structural geology
Blount County, Blount Springs inlier: Pitts, M. Michael, Jr. 5150

Alaska
Areal geology
Prince of Wales Island, Hollis and Twelvemile Creek areas: Herreid, Gordon. 5035
Earthquakes
Prince William Sound, March 28, 1964, free periods: Blum, P. A. 5424
Prince William Sound, March 28, 1964, tsunami data: Spaeth, M. G. 5138
Geochemistry
East-central, Taylor Highway region, geochemical prospecting: Saunders, R. H. 5260
Prince of Wales Island, Hollis and Twelvemile Creek areas, geochemical prospecting: Herreid, Gordon. 5035
Southeastern, selected areas, geochemical prospecting: Herbert, C. F. 5413
Glacial geology
Pribilof Islands, St. George, glaciers: Hopkins, D. M. 5415
Maps
Geologic and geochemical, Prince of Wales Island, Hollis area: Herreid, Gordon. 5035
Paleontology
Brachiopoda, Ordovician, Tatonduk River area: Ross, Reuben James, Jr. 5135
Stratigraphy
Devonian–Permian, Brooks Range, Anaktuvuk Pass: Porter, Stephen C. 5156
Structural geology
Brooks Range, Anaktuvuk Pass, deformation of Paleozoic section: Porter, Stephen C. 5156

Alberta
Absolute age
Jasper, Tekarra Creek map-area, muscovite: Steiner, J. 5326
Areal geology
Flathead map-area: Price, R. A. 5287
Wynd map-area, Jasper: Griffiths, R. E. 5054
Economic geology
Petroleum and natural gas, Upper Devonian fields: Belyea, Helen R. 5343
Hydrogeology
Alberta basin, formation waters, genesis: Graf, Donald L. 5392
Maps
Geologic, Flathead map-area: Price, R. A. 5253

Alberta
Maps
Geologic, Flathead map area: Price, R. A. 5287
Isallo stress, central: Lu, Paul H. 5353
Mineralogy
Clay minerals, southwestern, bentonites: Maiklem, W. R. 5056
Heavy mineral assemblage, Viking Sandstone, west central: Young, H. R. 5354
Paleontology
Cephalopoda and other fauna, Mississippian, Exshaw Formation, Jasper Park: Pamenter, C. B. 5049
Petrology
Jasper National Park, Permo-Carboniferous rocks: Walasko, J. T. 5348
Sedimentary petrology
Duhamel oil field, Nisku and Leduc Formations, reefoid facies and shales: Kirmani, Khalil Ullah. 5058
Jasper area, Precambrian sandstone sills: Bielenstein, H. U. 5042
West central, Viking Sandstone, heavy minerals and provenance: Young, H. R. 5354
Stratigraphy
Devonian, Beaverhill Lake Formation, bedding, third order: Anderson, Roger Y. 5192
Devonian, Beaverhill Lake Formation, lithofacies, succeeding sequences, correlation: Belyea, Helen R. 5343
Mississippian, Exshaw Formation, Jasper Park, age: Pamenter, C. B. 5049
Mississippian, Mount Head and Livingstone Formations, Highwood River area, section: Nielsen, Grant L. 5040
Permian, Ishbel Group and Belloy Formation, western: McGugan, A. 5018
Precambrian, Miette Formation, Tekarra Creek map area, Jasper: Steiner, J. 5326
Precambrian, Miette Formation, Wynd map area, Jasper: Griffiths, R. E. 5054
Structural geology
Sturgeon Lake South area, fault patterns, conformity to tectonic stresses: Lu, Paul H. 5353

Amphibia
Evolution
Frogs, jumping mechanism, origin: Gans, Carl. 5271
Fayella, n. gen.
Permian, Oklahoma, Chickasha Formation: Olson, Everett C. 5247
Nannospondylus, n. gen.
Permian, Oklahoma, Chickasha Formation: Olson, Everett C. 5247
Permian
Oklahoma, Chickasha Formation, Blaine-Grady Counties, new sites: Olson, Everett C. 5247

Angiosperms
Evolution
Cretaceous-Recent, deciduous and evergreen habits: Axelrod, Daniel I. 5270

Anthozoa
Chaetetes milleporaceus
Pennsylvanian, Indiana, redescription: Lane, G. N. 5200
Lithostrotion
Mississippian, Canada, Banff Formation and Rundle Group, type specimens, refined: Bamber, E. W. 5416
Lithostrotionella
Mississippian, Canada, Banff Formation and Rundle Group, type specimens, refined: Bamber, E. W. 5416
Thysanophyllum astraeiforme
Mississippian, Canada, Banff Formation and Rundle Group, type specimens, refined: Bamber, E. W. 5416

Appalachians
Economic geology
Polymetallic ores, southern, cupriferous pyrrhotite deposits: Carpenter, Robert Heron. 5204
Mineralogy
Sulfides, southern, cupriferous: Carpenter, Robert Heron. 5204

Arachnida
Palaeopisthacanthus schucherti
Pennsylvanian, Illinois, diagnosis and description: Vogel, B. R. 5201

Arctic
Maps
Magnetic, grid variation, epoch 1965.0: U.S. Coast and Geodetic Survey. 5124
Magnetic, horizontal intensity, epoch 1965.0: U.S. Coast and Geodetic Survey. 5121
Magnetic, inclination, epoch 1965.0: U.S. Coast and Geodetic Survey. 5120
Magnetic, total intensity, epoch 1965.0: U.S. Coast and Geodetic Survey. 5123
Magnetic, variation, epoch 1965.0: U.S. Coast and Geodetic Survey. 5335
Magnetic, vertical intensity, epoch 1965.0: U.S. Coast and Geodetic Survey. 5122

Arizona
Areal geology
Baboquivari Mts., Fresnal Canyon area: Fair, Charles Leroy. 5206
Mineralogy
Tsumebite, Morenci area: Nichols, M. C. 5324
Stratigraphy
Jurassic-Tertiary, Baboquivari, Comobabi, and Sierrita Mts., correlation: Fair, Charles Leroy. 5206
Pennsylvanian, Naco Formation, central: Brew, Douglas Crocker. 5203
Permian and Triassic, northern, cyclic patterns, chemical deposits: McKee, Edwin D. 5172

Artifacts
California
Mammoth Junction, obsidian, hydration dating: Michels, Joseph William. 5212
North America
Dating, earliest blades, points, and choppers: Willey, Gordon R. 5137
Associations
Alberta Society of Petroleum Geologists
Symposium, Canada, western, geologic history: McCrossan, R. G. 5032
Atlantic Coastal Plain
Economic geology
Phosphate, genesis: Pevear, D. R. 5409
Geomorphology
Virginia Carolinas, drainage pattern and capes: White, William A. 5304
Atlantic Ocean
Geophysical surveys
Grenada trough and Hatteras abyssal plain, acoustic reflection: Clay, C. S. 5314
Puerto Rico Trench, seismic, reflection: Bowin, C. O. 5306
Petrology
Puerto Rio Trench, ultramafic rocks: Bowin, C. O. 5306
Stratigraphy
Puerto Rico Trench, north wall: Bowin, C. O. 5306
Structural geology
United States, east coast, crustal studies 1965: Hales, A. L. 5108
Automatic data processing
Geophysics
Map compilation: Bhattacharyya, B. K. 5372
Basins, structural
Sedimentation
Canada, western, summary: Webb, J. B. 5023
Bentonite
Alberta
Southwestern, mineralogy: Maiklem, W. R. 5056
Bibliography
Authors
Bailey, Edward B.: MacGregor, A. G. 5063
Bandy, Mark Chance: Mason, Brian. 5059
Beckwith, Radcliffe Harold: Nace, Raymond L. 5060
Hayes, Albert Orion: Williams, M. Y. 5064
McLaughlin, Dean Benjamin: Willard, Bradford. 5061
Noble, Levi Fatzinger: Bradley, W. H. 5062
Montana
Geologic studies, unpublished: Chelini, J. M. 5317
Biography
Bailey, Edward B.
Bibliography: MacGregor, A. G. 5063
Bandy, Mark Chance
Bibliography: Mason, Brian. 5059
Beckwith, Radcliffe Harold
Bibliography: Nace, Raymond L. 5060
Frick, Childs: Anthony, Harold E. 5238
Hannibal, Harold: Smith, Allyn G. 5116
Biography
Hayes, Albert Orion
Bibliography: Williams, M. Y. 5064
Houghton, Douglass: Wallin, Helen. 5117
McLaughlin, Dean Benjamin
Bibliography: Willard, Bradford. 5061
Noble, Levi Fatzinger
Bibliography: Bradley, W. H. 5062
VerPlanck, William E.: Bowen, Oliver E., Jr. 5139
Brachiopoda
Devonian
Pennsylvania, Mahantango Formation: Ellison, Robert L. 5293
Ordovician
Alaska, Tatonduk River area, descriptions, age and correlation: Ross, Reuben James, Jr. 5135
Pennsylvanian–Permian
Nomenclature, revised, list: Moore, Raymond C. 5173
Branchiopoda
Conchostracans
Permian, Kansas–Oklahoma, Wellington Formation, cyclic occurrence: Tasch, Paul. 5399
British Columbia
Areal geology
Flathead map–area: Price, R. A. 5287
Economic geology
Polymetallic ores, Vancouver North–Coquitlam–Pitt Lake map–areas: Roddick, J. A. 5366
Maps
Geologic, Coquitlam map–area: Roddick, J. A. 5256
Geologic, Flathead map–area: Price, R. A. 5253
Geologic, Flathead map–area: Price, R. A. 5287
Geologic, Pitt Lake map–area: Roddick, J. A. 5254
Geologic, Vancouver North, Coquitlam, and Pitt Lake map–areas: Roddick, J. A. 5366
Geologic, Vancouver North map–area: Roddick, J. A. 5255
Paleontology
Fauna, Permian, Cache Creek Group, limestone assemblages: McGugan, A. 5018
Petrology
Vancouver North–Coquitlam–Pitt Lake map–areas, plutonic rocks, origin and evolution: Roddick, J. A. 536
Sedimentary petrology
Fort Saint John area, Ordovician rocks, provenance and history: Tedrick, R. L. 5053
Stratigraphy
Permian, Cache Creek Group, central and Pacific coast: McGugan, A. 5018
Structural geology
Fort Saint John area, tectonic history: Tedrick, R. L. 5053
Vancouver North–Coquitlam–Pitt Lake map–areas: Roddick, J. A. 5366

British Columbia
Volcanology
Coast Ranges, Quaternary, lava and ash distribution: Barton, Robert H. 5021

California
Absolute age
Granitic rocks, Sierra Nevada, K Ar: Kistler, R. W. 5302
Tomales Bay, Pleistocene marine shells: Richards, Horace G. 5387
Areal geology
Mojave Desert, Halloran Hills: Warnke, Detlef Andreas. 5219
Economic geology
Limestone, dolomite, quartzite, metals, Victorville area: Bowen, Oliver E., Jr. 5398
Engineering geology
Dams and tunnels, North Coastal area, water resources development: Baumli, George R. 5318
Watershed development, Eel River basin: Hawkins, Richard H. 5365
Geomorphology
Eel River basin, topography and drainage pattern: Hawkins, Richard H. 5365
Imperial Valley, barchan dunes, origin and characteristics: Norris, Robert M. 5034
Geophysical surveys
San Francisco region, radioactivity, airborne: Books, Kenneth G. 5152
Hydrogeology
Eel River basin, valley alluvium: Hawkins, Richard H. 5365
North Coastal area, resources development: Baumli, George R. 5318
Magnetic surveys
Lassen Volcanic Nat'l. Park, Recent basalt: James, David E. 5308
Maps
Geologic, Mt. Hamilton quadrangle, east half: Soliman, Soliman M. 5389
Geologic, Oroville quadrangle: Creely, Robert Scott. 5296
Geologic, Quartzite Mtn. and vicinity near Oro Grande: Bowen, Oliver E., Jr. 5398
Geologic, Waucoba Mountain quadrangle: Nelson, C. A. 5252
Radioactivity, San Francisco region, airborne: Books, Kenneth G. 5152
Mineralogy
Vonsenite, Monterey County: Chesterman, Charles W. 5072
Paleontology
Flora, Pleistocene, Riverside County, Soboba group: Axelrod, Daniel I. 5284
Petrology
Lassen Volcanic Nat'l. Park, basalt flows: James, David E. 5308
Mount Hamilton quadrangle, Isabel–Eylar area, Franciscan Formation, provenance: Soliman, Soliman M. 5389

California
Stratigraphy
Carboniferous(?), Oro Grande Series, Victorville area, revision: Bowen, Oliver E., Jr. 5398
Mesozoic, Franciscan Formation, Mt. Hamilton quadrangle, Isabel–Eylar area: Soliman, Soliman M. 5389
Paleozoic–Recent, Oroville quadrangle: Creely, Robert Scott. 5396
Precambrian–Cambrian, Death Valley: Wright, Lauren A. 5191
Tertiary, Monterey Formation, bedding, third order: Anderson, Roger Y. 5192
Waucoba Mountain quadrangle, sections: Nelson, C. A. 5252
Structural geology
Death Valley, Mojave block, existence in Precambrian: Wright, Lauren A. 5191
Oroville quadrangle, angular unconformity, bedrock deformation: Creely, Robert Scott. 5396
Victorville area, Oro Grande Series, folding and faulting: Bowen, Oliver E., Jr. 5398

Cambrian
California
Death Valley, stratigraphy: Wright, Lauren A. 5191
Canada
Cordilleran and Plains regions, stratigraphy: vanHees, Hendrik. 5347
Mississippi Valley
Cyclic patterns and lithotopes: Ostrom, Meredith Eggers. 5174
Utah
Western, Porifera, Marjum Formation: Rigby, Keith J. 5198
Vermont
Northwestern, Trilobita, Hungerford Slate, nomenclature: Shaw, Alan B. 5371
Wisconsin
Saint Croix Series, cyclic patterns and faunal zones, discontinuities: Raasch, Gilbert O. 5342

Canada
Absolute age
Precambrian, western, time–rock units: Burwash, R. A. 5010
Areal geology
Western, geological history, summary: Nelson, S. J. 5346
Economic geology
Coal, petroleum and natural gas, western, Jurassic occurrences: Springer, G. D. 5349
Coal, petroleum and natural gas, western, Lower Cretaceous occurrences: Rudkin, R. Alan. 5350
Mineral resources, Precambrian shield: Wilson, M. E. 5385
Mineral resources, western, Upper Cretaceous occurrences: Williams, Gordon D. 5351
Petroleum and natural gas, western, Carboniferous traps: Macauley, G. 5017

Canada
Economic geology
Uranium-thorium, Elliot Lake, resources: Griffith, J. W. 5158
Uranium-thorium, production and reserves, 1964-2000: Faulkner, R. L. 5412
Geochemistry
Western, crude oil, natural gas, formation waters, regional variations: Hitchon, Brian. 5022
Glacial geology
Western, drift, landforms and drainage changes: Barton, Robert H. 5021
Maps
Geologic and paleogeographic, western, Middle Devonian, Elk Point Group: Grayston, L. D. 5016
Geologic and paleogeologic, western, Jurassic: Springer, G. D. 5349
Geologic, western: Nelson, S. J. 5346
Geologic, western, atlas: McCrossan, R. G. 5032
Geologic, western, Cambrian: vanHees, Hendrik. 5347
Geologic, western, Carboniferous: Macauley, G. 5017
Geologic, western, Ordovician-Silurian: Porter, J. W. 5015
Geologic, western, Permian: McGugan, A. 5018
Geologic, western, Quaternary: Barton, Robert H. 5021
Geologic, western, stratigraphic distribution and tectonic units: Webb, J. B. 5023
Geologic, western, Tertiary: Taylor, R. Spence. 5020
Geologic, western, Upper Devonian units: Belyea, Helen R. 5343
Paleogeologic and geographic, western, Upper Cretaceous: Williams, Gordon D. 5351
Paleogeologic, western, Lower Cretaceous: Rudkin, R. Alan. 5350
Paleogeologic, western, Triassic: Barss, D. L. 5019
Paleontology
Anthozoa, Mississippian, Banff Formation and Rundle Group, western, lithostrotionid: Bamber, E. W. 5416
Petrology
Shield, Precambrian: Wilson, M. E. 5385
Stratigraphy
Cambrian, Cordilleran and Plains regions, lithofacies: vanHees, Hendrik. 5347
Carboniferous, Plains area and Rocky Mountains: Macauley, G. 5017
Cretaceous, Lower, western: Rudkin, R. Alan. 5350
Cretaceous, Upper, western: Williams, Gordon D. 5351
Devonian, Elk Point Group, Plains and Cordilleran basins: Grayston, L. D. 5016
Devonian, Upper, western, correlation, lithofacies: Belyea, Helen R. 5343

Canada
Stratigraphy
Jurassic, western, lithofacies, paleogeography: Springer, G. D. 5349
Ordovician-Silurian, Cordillera and Plains regions, lithofacies: Porter, J. W. 5015
Precambrian, shield: Wilson, M. E. 5385
Precambrian, western, time-rock units: Burwash, R. A. 5010
Quaternary, western: Barton, Robert H. 5021
Tertiary, western: Taylor, R. Spence. 5020
Triassic, western, Intervals A, B, and C: Barss, D. L. 5019
Western, regional correlation chart, cross sections: Nelson, S. J. 5346
Western, summary: Webb, J. B. 5023
Western, symposium: McCrossan, R. G. 5032
Structural geology
Shield, Precambrian: Wilson, M. E. 5385
Western, Tertiary, uplift and deformation: Taylor, R. Spence. 5020
Carboniferous
California
Victorville area, Oro Grande Series: Bowen, Oliver E., Jr. 5398
Canada
Western, Kinderhookian to Chesterian-Pennsylvanian: Macauley, G. 5017
Caribbean region
Paleontology
Ostracoda, Miocene, assemblages: Bold, W. A. van den. 5011
Structural geology
Geosynclinal evolution and tectonics, Jurassic-Quaternary, Cuba: Furrazola-Bermudez, Gustavo. 5338
Caves
Flow markings
Scallops and flutes: Curl, Rane L. 5289
United States
Popular account: Halliday, William R. 5231
Cenozoic
California
Oroville quadrangle, stratigraphy, uplift: Creely, Robert Scott. 5396
Cuba
Tectonic and depositional history: Furrazola-Bermudez, Gustavo. 5338
West Indies
Martinique, stratigraphy: Grunevald, Henri. 5278
Changes of level
Kansas
Paleozoic seas, late, staggered transgressions: Elias, Maxim K. 5161
North America
Craton, relation to stratigraphic sequences: Sloss, L. L. 5178
Pacific Ocean
Pleistocene high stand, coral reef ages: Veeh, Hans Herbert. 5218
Texas
Pennsylvanian-Permian: VanSiclen, D. C. 5181

Chemical analysis
Polarograph
Uranium in phosphate: Habashi, Fathi. 5356
Clay mineralogy
Areal studies
Alberta, southwestern, upper Cretaceous bentonites: Maiklem, W. R. 5056
Georgia, DeKalb County, residual clay, cf. British Guiana: Grant, Willard H. 5100
Mexico, northern Pacific Coast sediments: delaTorre, Jorge. 5281
New York, Long Island Sound: McCrone, A. W. 5129
Experimental studies
Montmorillonite, water–vapor interaction: Roderick, Gilbert Leroy. 5216
Clays
Kentucky
Farmington quadrangle, resources: Finch, Warren I. 5237
Pennsylvania
Somerset County, resources: Flint, Norman K. 5383
Coal
Kentucky
Bruin quadrangle, resources: Englund, Kenneth J. 5251
Ketchen quadrangle, resources: Englund, Kenneth J. 5411
Sandy Hook quadrangle, resources: Englund, Kenneth J. 5144
Pennsylvania
Somerset County, resources: Flint, Norman K. 5383
Tennessee
Ketchen quadrangle, resources: Englund, Kenneth J. 5411
Cobalt
Geochemistry
Distribution in sulfide deposits, Saskatchewan, Flin Flon area: Faulkner, Edward Leslie: 5420
Colorado
Areal geology
Jefferson area: Yacoub, Nazieh K. 5014
Economic geology
Uranium, Schwartzwalder mine, occurrence, production, reserves: Downs, George R. 5422
Glacial geology
Grand Mesa area: Yeend, Warren Ernest. 5221
Magnetic surveys
Jefferson area: Yacoub, Nazieh K. 5014
Mineralogy
Clinohumite, Cotopaxi, Precambrian: Salotti, Charles A. 5000
Schwartzwalder mine, uranium-bearing vein deposits: Downs, George R. 5422
Paleontology
Fauna, Cretaceous, Colorado and Montana Groups: Smith, James H. 5332
Foraminifera, Cretaceous, Carlile Shale, Pueblo area, paleoecology: Eicher, Don L. 5295
Colorado
Stratigraphy
Cretaceous, Carlile Shale, Pueblo area, Rock Canyon section: Eicher, Don L. 5295
Cretaceous, Colorado and Montana Groups, post-Carlile: Smith, James H. 5332
Cretaceous, Dakota Sandstone, nomenclature, San Juan basin: Owen, D. E. 5157
Cretaceous, Moffat County, Dry Mtn. area, No. 1 Raeder-Government well log: Ritzma, Howard R. 5074
Pennsylvanian and Permian, central, sedimentary environments: DeVoto, Richard H. 5250
Pennsylvanian, cyclic patterns: Chronic, John. 5160
Quaternary, Grand Mesa area, new formations: Yeend, Warren Ernest. 5221
Tertiary, Florissant lake beds, bedding, second-order: Anderson, Roger Y. 5192
Structural geology
Central, Pennsylvanian tectonics: DeVoto, Richard H. 5250
Milsap Creek fault, origin by gravity sliding: Gerhard, Lee C. 5419
Moffat County, Sparks-Uinta thrust sheet, No. 1 Raeder-Government well: Ritzma, Howard R. 5074
Schwartzwalder mine, fractures: Downs, George R. 5422
Concretions
Genesis
Nevada, Nye County, rhizoconcretions: Luft, Stanley J. 5369
Connate water
Genesis
Evidence, O 18 and deuterium fractionation by shale micropore systems: Graf, Donald L. 5392
Connecticut
Petrology
Thomaston quadrangle, granitic gneiss: Cassie, Robert MacGregor. 5205
Structural geology
Thomaston quadrangle, domal granitic gneiss: Cassie, Robert MacGregor. 5205
Conodonts
Devonian
Nevada-Utah, biostratigraphy: Clark, D. L. 5199
Continental shelf
General
Economic geology, resources, development legislation: Ely, Northcutt. 5102
Cratering
Experimental studies
PLOWSHARE program, engineering applications: Johnson, G. W. 5408
Cretaceous
Canada
Western, Lower, stratigraphy: Rudkin, R. Alan. 5350

Cretaceous
Canada
Western, Upper, stratigraphy: Williams, Gordon D. 5351
Colorado
Moffat County, Dry Mtn. area, No. 1 Raeder Government well: Ritzma, Howard R. 5074
Northwestern, Colorado and Montana Groups, post-Carlile, stratigraphy: Smith, James H. 5332
Pueblo area, Foraminifera, Carlile Shale, paleoecology: Eicher, Don L. 5295
San Juan basin, Dakota Sandstone, nomenclature: Owen, D. E. 5157
Correlation
Wyoming-Utah-Colorado, chart: Hale, L. A. 5333
Montana
Shawmut anticline, palynomorphs: Melchior, Robert Charles. 5211
New Mexico
San Juan Basin, cycles: Sabins, Floyd F., Jr. 5226
San Juan basin, Dakota Sandstone, nomenclature: Owen, D. E. 5157
South Dakota
North-central, Fox Hills Formation: Waage, Karl M. 5182
Texas
Central, Fredericksburg Group, lower sandstones: Moore, C. H., Jr. 5405
United States
Western Interior, petrographic criteria for environments: Sabins, Floyd F., Jr. 5226
Utah
Northeastern, Colorado and Montana Groups, post-Carlile, stratigraphy: Smith, James H. 5332
Wyoming
Blair and Rock Springs Formations: Keith, Robert E. 5126
Rock Springs area, Fox Hills Sandstone, depositional environment: Harms, J. C. 5337
Rock Springs uplift, Almond Formation: Jacka, Alonzo D. 5118
Rock Springs uplift, Almond Formation, measured sections: Lewis, J. L. 5331
Rock Springs uplift area, Late, pre-Laramide: Roehler, Henry W. 5125
Rock Springs uplift, Mesaverde Group, and Rock Springs Formation: Burger, John A. 5127
South-central, Colorado and Montana Groups, post-Carlile, stratigraphy: Smith, James H. 5332
Vertebrata, faunas, environments, climatic significance: Ostrom, John H. 5330
Wamsutter arch, Almond and Lewis Formations: Weimer, Robert J. 5128

Crust
Atlantic Ocean
Continental shelf, United States, 1965 seismic studies: Hales, A. L. 5108
Evolution
Continents and ocean basins, history: Hess, H. H. 5267

Crystal chemistry
Bonding
Techniques, analysis of Zeeman zero crossing data: Peterson, G. E. 4995
Diamond
Reaction with boron under pressure: Dickinson, S. K., Jr. 5073
Fe–Mn orthophosphate hydrates
Classification: Moore, Paul B. 5065
K-feldspar
Al-Si order-disorder relations: Dietrich, R. V. 4985
Lithium aluminogermanate
Polymorphism of spinel phenacite structures: Gaines, A. M. 4987
Manganese nodules
Trace elements, interelement relations and phase enrichment: Burns, Roger G. 5327
Mizzonite
Al distribution in framework and role of carbonate: Papike, J. J. 4992

Crystal structure
Apatite
Carbonate position in structure, synthetic: Zapanta LeGeros, Racquel. 5328
Binnite
Comparison with tetrahedrite: Wuensch, B. J. 5003
Biotite polytypes
Vector relations as identification criteria: Ross, M. 4999
Bonattite
First determination: Zahrobsky, R. 5004
Epistilbite
First determination, relation to mordenite and dachiardite: Kane, W. T. 4988
Larsenite
Refinement: Prewitt, C. T. 4996
Laueite
Data and technique: Moore, Paul B. 5065
Lorandite
Refinement: Knowles, Charles R. 4989
Melanophlogite: Appleman, Daniel E. 5067
Metastrengite
Data and technique: Moore, Paul B. 5065
Mizzonite
Quebec, Grenville: Papike, J. J. 4992
Rhodizite
Solution as basis for chemical formula: Buerger, Martin K. 5390
Silicates
Thermal parameters, atomic model: Burnham, Charles W. 5070
Tetrahedrite
Comparison with binnite: Wuensch, B. J. 5003
Tsumebite
Arizona, Morenci area: Nichols, M. C. 5324

Crystallography
Methods
Crystal orientation, X-ray method: Brooker, E. J. 5290
Polytype identification for biotite: Ross, M. 4999
Polymorphism and polytypism
Textbook: Verma, Ajit Ram. 5229
Cuba
Geomorphology
Regional, shoreline, and karst features: Furrazola-Bermudez, Gustavo. 5338
Maps
Geologic, general, and paleogeographic, Jurassic-Quaternary: Furrazola-Bermudez, Gustavo. 5338
Petrology
Igneous intrusives, volcanic eruptives, Mesozoic-Cenozoic: Furrazola-Bermudez, Gustavo. 5338
Stratigraphy
Mesozoic-Cenozoic, geosynclinal lithofacies, fauna: Furrazola-Bermudez, Gustavo. 5338
Deformation
Experimental studies
Quartz, basal slip: Bhattacharyya, D. S. 5345
Quartz, basal slip: Christie, J. M. 5009
Stress
Isallo theory applied to central Alberta: Lu, Paul H. 5353
Deserts
Processes
Barchan dune formation, movement: Norris, Robert M. 5034
Devonian
Alberta
Beaverhill Lake Formation: Belyea, Helen R. 5343
Duhamel oil-field, Nisku and Leduc Formations: Kirmani, Khalil-Ullah. 5058
Alberta-British Columbia
Flathead map-area, stratigraphy: Price, R. A. 5287
Canada
Plains and Cordilleran basins, Elk Point Group: Grayston, L. D. 5016
Western, Upper units, correlation, lithofacies: Belyea, Helen R. 5343
Michigan
Lucas Formation, evaporite cycles: Haney, Warren D. 5165
Nevada
Eastern and central, conodonts and biostratigraphy: Clark, D. L. 5199
New York
Keuka Lake area, Bluff Point Siltstone: Sutton, Robert G. 5029
Ohio
Cleveland area, Pisces, Cleveland Shale: Hlavin, W. J. 5296
Pennsylvania
Altoona-Gallitzin area, stratigraphy: Swartz, Frank M. 5370
Devonian
Pennsylvania
South-central, Mahantango Formation, Invertebrata: Ellison, Robert L. 5293
Utah
Central and western, conodonts and biostratigraphy: Clark, D. L. 5199
Diagenesis
Experimental studies
Aragonite and vaterite, Mg-ion effect on rate of conversion to calcite: McLaren, Eugene. 4991
Rhizoconcretions
Nevada, Nye County, bedded tuff: Luft, Stanley J. 5369
Diamonds
Geochemistry
Reaction with boron: Dickinson, S. K., Jr. 5073
Differential thermal analysis
Methods
Piston-cylinder apparatus for phase transformations: Cohen, L. H. 5380
Dolomite
California
Victorville area, Oro Grande Series, resources: Bowen, Oliver E., Jr. 5398
Texas
Resources and production, Lower Cretaceous sources: Rodda, Peter U. 5119
Drainage changes
Canada
Western, preglacial and present patterns: Barton, Robert H. 5021
Dunes
California
Imperial Valley, barchans, origin and characteristics: Norris, Robert M. 5034
Earth
History
Popular account: Simak, Clifford D. 5227
Interior
Explosion seismology data, southeastern U.S.: Werth, Glenn. 5279
Study by reactor probe, melting penetration: Adams, William Mansfield. 5273
Origin
Popular account: Page, Thornton. 5232
Surface
Evolution of continents, oceans, atmosphere, history: Hess, H. H. 5267
Earthquakes
Alaska
March 28, 1964, free periods: Blum, P. A. 5424
March 28, 1964, tsunami data: Spaeth, M. G. 5138
Instruments
Seismometers, large aperture array: Frosch, R. A. 5262
Ultra-long period seismometers: Blum, P. A. 5424

Earthquakes
Mechanism
Experimental study, deformation of hydrous phases in upper mantle: Riecker, R. E. 5106
Fault-plane solutions, statistical analysis: Pulpan, Hans. 5272
Washington, Puget Sound, 1965 epicenter, magnetic survey: Kaarsberg, Ernest A. 5093
Prediction
Statistical model of hazards: Borgman, Leon E. 5300
Statistical model of hazards: Lomnitz, C. 5301
Ecology
Florida
Marine: Lynts, George W. 5026
Economic geology
Methods
Computing reserves, principles: Popoff, Constantine C. 5225
Resources
Ocean, production problems, technological developments: Wolfe, John A. 5104
Elastic properties
Igneous rocks
Stress wave transmission and decay: Goldsmith, Werner. 5312
Electrical exploration
Methods
Resistivity, vertical and horizontal profiling in ground-water exploration: Wessels, Gerhardus J. M. 5388
Electrical surveys
Ontario
Big Creek region, ground-water resources: Wessels, Gerhardus J. M. 5388
Texas
Delaware basin, resistivity sounding, technique and instrumentation: Word, Darrell R. 5012
Engineering geology
Clays
Montmorillonite, water-vapor interaction: Roderick, Gilbert Leroy. 5216
Dams
California, North Coastal area, water resources: Baumli, George R. 5318
Nuclear explosions
Application tests, PLOWSHARE program: Johnson, G. W. 5408
Shorelines
Equilibrium, tidal cycle of change: Strahler, Arthur N. 5031
Tunnels
California, North Coastal area, water resources: Baumli, George R. 5318
Epeirogenesis
Precambrian
Canada, western: Burwash, R. A. 5010
Erosion
Beaches
Alaska: Stanley, Kirk W. 5007
Equilibrium, tidal cycle of change: Strahler, Arthur N. 5031
Erosion
Lake basins
Texas, High Plains, formation: Reeves, C. C., Jr. 5033
Estuaries
Sedimentation
Phosphate: Pevear, D. R. 5409
Evolution
Amphibia
Frogs, jumping mechanism, origin: Gans, Carl. 5271
Angiosperms
Cretaceous-Recent, deciduous and evergreen habits: Axelrod, Daniel I. 5270
Concepts
Life origin: Hess, H. H. 5267
Life origin: Wald, George. 5368
General
Textbook: Olson, Everett C. 5114
Mammalia
Primates, textbook: Buettner-Janusch, John. 5377
Man, fossil
Textbook: Brace, C. L. 5374
Textbook: Buettner-Janusch, John. 5377
Reptilia
Captorhinomorpha, upper Paleozoic, middle ear, relationships: Fox, Richard C. 5320
Vertebrata
Tetrapods, middle ear, path of chorda tympani: Fox, Richard C. 5294
Explosion phenomena
Experimental studies
Salmon seismic experiment, southeastern U.S.: Werth, Glenn. 5279
Faults
Gravity
British Columbia, Flathead fault: Price, R. A. 5287
Overthrust
Alaska, Brooks Range, Anaktuvuk Pass: Porter, Stephen C. 5156
Alberta, Lewis fault: Price, R. A. 5287
Colorado, Milsap Creek fault, origin by gravity sliding, not thrusting: Gerhard, Lee C. 5419
Colorado, Moffat County, Sparks-Uinta sheet: Ritzma, Howard R. 5074
Nevada-Utah, Kern Mts., Snake and Deep Creek Ranges: Nelson, Robert B. 5155
Utah, Blue Mtn. and Wah Wah plates: Miller, Gerald M. 5153
Utah, western, San Francisco Mts.: East, Edwin H. 5154
Systems
Greenland, Gardar rift zone: Sorensen, Henning. 5386
Wyoming, Henry's Fork fault, extension, Sweetwater County: Wiegman, Ronald W. 5078
Florida
Maps
Oil and gas, Sunoco-Felda field, Hendry-Collier Counties: Florida Division of Geology. 5113

Florida
Paleontology
Mammalia, Pleistocene, Felidae: Kurten, Bjorn. 5244
Sedimentary petrology
Marine sediments, grain size distribution relation to ecology: Lynts, George W. 5026
Folds
Anticlinal
Alabama, Blount Springs inlier: Pitts, M. Michael, Jr. 5150
Foraminifera
Cretaceous
Colorado, Pueblo area, Carlile Shale, descriptions, paleoecology: Eicher, Don L. 5295
Elphidium
Morphological groups: Buzas, M. A. 5363
Fossils, problematic
Ordovician
Ohio, Cincinnatian Series: Osgood, Richard Grosvenor, Jr. 5214
Ophiomorpha
Cretaceous, U.S., shallow marine indicator, cf. *Callianassa major* burrow: Hoyt, John H. 5086
Fractures
Joints
Montana, Royal stock, Flint Creek Range: Allen, Jack C., Jr. 5307
Washington, Grand Coulee area, Columbia River basalts: Lefebvre, Richard H. 5101
Gas, natural
Alberta
Upper Devonian fields: Belyea, Helen R. 5343
Canada
Western, geochemistry, regional variations: Hitchon, Brian. 5022
Geochemistry
Regional variations, Canada, western: Hitchon, Brian. 5022
Kentucky
Northeastern, Knox Dolomite, possibilities: McGuire, William H. 5195
Western, exploration and discoveries 1963–64: Rose, William D. 5194
Western, reservoirs, relation to gravity anomalies: McGuire, William H. 5013
Western, underground storage, well logging application: Brown, J. A. 5222
Oregon
Exploration: Stewart, R. E. 5379
Properties
Regional variations, Canada, western: Hitchon, Brian. 5022
Texas
Gulf Coastal Province, occurrence and production, summary: Fisher, W. L. 5291
Wyoming
Wamsutter arch: Weimer, Robert J. 5128
Gastropoda
Tertiary
Oregon, Washington, Oligocene–Pliocene, n. sp.: Addicott, W. O. 5299
General
Dictionary
Basic: Graham, E. C. 5375
Indexes
International Conference on Peaceful Uses of Atomic Energy, 3d, Geneva, 1964, Proceedings: United Nations. 5241
Practice
Basic research, complexity, U.S. Geological Survey program: Pecora, William T. 5103
Geologist in construction work: Leroy, L. W. 5259
Guide to prospective geologists: Weitz, Joseph L. 5373
Petroleum geologist, economic factor, importance: Halbouty, Michel T. 5249
Science
Nature and place of geology: Spieker, Edmund M. 5321
Symposium
Canada, western, geologic history: McCrossan, R. G. 5032
Textbooks
Basic concepts: Foster, Robert J. 5376
Crystallography, polymorphism and polytypism: Verma, Ajit Ram. 5229
Hydrogeology: Davis, Stanley N. 5039
Geochemical surveys
Alaska
Metals, stream sediments, east-central, Taylor Highway region: Saunders, R. H. 5260
Metals, stream sediments, southeastern, selected areas: Herbert, C. F. 5413
Stream sediments, Prince of Wales Island, Hollis and Twelvemile Creek areas: Herreid, Gordon. 5035
Montana
Metals, stream sediments, Flathead–Lincoln Counties: Sahinen, U. M. 5395
Geochemistry
Methods
Differential thermal analysis for phase transformations, apparatus: Cohen, L. H. 5380
Processes
Diffusion, pressure gradient effect in deep-seated rocks: Gresens, Randall L. 5355
Geochronology
General
Archeology, applications: Rainey, Froelich. 5136
Hydration of glass
Obsidian, Mammoth Junction, Calif.: Michels, Joseph William. 5212
Rate in rhyolitic: Friedman, Irving. 5310
Geologic thermometry
Iron–titanium deposits
North America: Lister, Gordon F. 5410
Geological exploration
Technique
U.S. Geological Survey program, complexity: Pecora, William T. 5103

Geomorphology
Environment
Coastal plain, drainage pattern and cape development: White, William A. 5304
Fluvial features
Meanders, geometry and theory: Leopold, L. B. 5239
Glacial features
Alaska, Pribilof Islands, St. George, Pleistocene: Hopkins, D. M. 5415
Missouri, St. Louis area: Goodfield, Alan Granger. 5316
Landform description
Drainage pattern, Wisconsin, Driftless Area: Palmquist, Robert Clarence. 5215
Geophysical exploration
Methods
Reactor probe for study of Earth's interior, melting penetration: Adams, William Mansfield. 5273
Geophysics
General
Hazards, statistical models: Borgman, Leon E. 5300
Hazards, statistical models: Lomnitz, C. 5301
Interpretation
Exploration techniques, future evolution: Brant, Arthur A. 5339
Methods
Map compilation from computer processed results: Bhattacharyya, B. K. 5372
Georgia
Economic geology
Granite, Elberton district, pink color, origin: Ramspott, L. D. 5096
Geomorphology
Barrier island system: Hoyt, John H. 5084
Mineralogy
Ruby, Batesville area, saprolite nodules: Forbes, Warren C. 5091
Paleontology
Flora, Paleocene–Eocene, Adairsville area, clay lens from bauxite: Stanley, Edward A. 5090
Pisces, Mississippian, Bangor Limestone, Dade County, shark: Cramer, Howard Ross. 5094
Petrology
Batesville area, saprolite, ruby bearing nodules: Forbes, Warren C. 5091
Sedimentary petrology
Mount Arabia, Recent arkosic alluvium, gneissic source: Spalvins, K. 5095
Seismic surveys
Atlanta area, crustal and mantle velocities: Dorman, LeRoy M. 5098
Weathering
DeKalb County, residual clay minerals, cf. British Guiana: Grant, Willard H. 5100
Geosynclines
Caribbean region
Evolution, Mesozoic–Cenozoic, Cuba region: Furrazola-Bermudez, Gustavo. 5338
Geothermal energy
New Mexico
Resources, review: Summers, W. K. 5297
Utah
Resources, review: Heylmun, Edgar B. 5298
Glacial features
Moraines
Northwest Territories, Baffin Island, Isortoq Valley, genesis: Andrews, J. T. 5037
Glacial geology
Canada
Western, drift, landforms, drainage changes: Barton, Robert H. 5021
Massachusetts
Greenfield quadrangle: Jahns, Richard H. 5112
Ontario
Dundas Valley: Hurst, Donald Lindsay. 5046
Glossaries
Science
Dictionary: Graham, E. C. 5375
Graptolithina
Morphology
Relation to Coelenterata and Pterobranchia: Kozlowski, Roman. 5197
Gravel
Indiana
Johnson and Shelby Counties, resources: Carr, Donald D. 5283
Kentucky
Farmington quadrangle, resources: Finch, Warren I. 5237
Puerto Rico
Resources: Gelabert, P. A. 5285
Gravity surveys
Kentucky
Western, relation of Bouguer anomalies to oil and gas reservoirs: McGuire, William H. 5013
Greenland
Petrology
Disko, basalt series with native iron: Vaasjoki, O. 5030
Gardar rift zone, volcanic rocks and related intrusions: Sorensen, Henning. 5386
Stratigraphy
Precambrian: Berthelsen, Asger. 5277
Structural geology
Gardar rift system: Sorensen, Henning. 5386
Precambrian: Berthelsen, Asger. 5277
Ground water
California
Resources, Eel River basin: Hawkins, Richard H. 5365
Canada
Composition, western, Paleozoic formations, regional variations: Hitchon, Brian. 5022
Hawaii
Resources, Molokai: Hawaii Div. Water and Land Devel. 5391
Louisiana
Resources, Lake Pontchartrain area: Cardwell, G. T. 5275
Resources, Rapides Parish: Newcome, Roy, Jr. 5276

Ground water
Ontario
Resources, Big Creek region, electrical surveys: Wessels, Gerhardus J. M. 5388
South Carolina
Salt-water intrusion, coastal areas: Siple, George E. 5036
Texas
Resources and aquifers, Lee County: Thompson, Gerald L. 5393
Gulf Coastal Plain
Stratigraphy
Tertiary, northern, Eocene cycles: Fisher, W. L. 5162
Gulf of California
Sedimentary petrology
Colorado River delta, tidal flat sedimentation: Thompson, Robert Wayne. 5083
Gulf of Mexico
Magnetic surveys
Anomalies: Heirtzler, J. R. 5394
Maps
Magnetic, anomalies: Heirtzler, J. R. 5394
Hawaii
Hydrogeology
Molokai, ground-water: Hawaii Div. Water and Land Devel. 5391
Maps
Ground water, Molokai: Hawaii Div. Water and Land Devel. 5391
Heavy minerals
Alberta
West-central, Viking Sandstone provenance: Young, H. R. 5354
Exploration
River sands, determining relative amounts: Young, Edward J. 5025
History
Geological research
Wisconsin: Black, Robert F. 5282
Hydrogeology
Experimental studies
Paleo-flow interpretation: Jopling, Alan V. 5352
Genesis
Formation waters, saline, isotope evidence: Graf, Donald L. 5392
Resource development
California, North Coastal area: Baumli, George R. 5318
Textbooks
General: Davis, Stanley N. 5039
Hydrothermal alteration
Georgia
Granite, Elberton district, gray to pink color, structural control: Ramspott, L. D. 5096
Idaho
Areal geology
Priest River area: Barnes, Charles Winfred. 5202
Igneous rocks
Alkalic
Petrogenesis, phase equilibria: Bailey, D. K. 5268
Igneous rocks
Anorthosite-mangerite
Petrogenesis, Quebec, Morin Series: Philpotts, A. R. 5269
Basalt
Composition, contamination, California: James, David E. 5308
Petrology, Greenland, Disko series: Vaasjoki, O. 5030
Petrology, Washington, central, Tertiary dikes and sills: Southwick, David L. 5242
Differentiation
Fe-Ti oxides: Lister, Gordon F. 5410
Ni-pyrrhotite ores: Desborough, George A. 5146
Northwest Territories, Muskox intrusion: Pouliot, G. 4994
General
Geochemistry, analyses, New Hampshire: Billings, Marland P. 5336
Petrology, Cuba, intrusive and volcanic: Furrazola-Bermudez, Gustavo. 5338
Granite
Color, tectonic origin, Elberton pink, Georgia: Ramspott, L. D. 5096
Granodiorite
Petrology, Montana: Allen, Jack C., Jr. 5307
Intrusives
Greenland, Gardar rift zone: Sorensen, Henning. 5386
Physical properties
Elasticity, stress wave transmission: Goldsmith, Werner. 5312
Rhyolite
Geochemistry, rate of hydration and perlite formation: Friedman, Irving. 5310
Volcanic ash
Alteration, concretion formation, Nevada: Luft, Stanley J. 5369
Volcanics
Composition, West Indies, Martinique, chemical analyses: Grunevald, Henri. 5278
Greenland, Gardar rift zo..e: Sorensen, Henning. 5386
Illinois
Economic geology
Mineral resources, East St. Louis region: Major, Robert L. 5038
Glacial geology
Douglas County, Lake Douglas: Gardiner, M. J. 5005
Paleontology
Arachnida, Pennsylvanian, *Palaeopisthacanthus schucherti*: Vogel, B. R. 5201
Weathering
Douglas County, soils: Gardiner, M. J. 5005
Indiana
Economic geology
Gravel and sand, eastern Johnson and western Shelby Counties: Carr, Donald D. 5283
Geophysical surveys
Eastern, radioactivity, airborne: Bates, Robert G. 5151

Indiana
Maps
Radioactivity, eastern, airborne: Bates, Robert G. 5151
Paleontology
Anthozoa, Pennsylvanian, *Chaetetes milleporaceus*, redescription: Lane, G. N. 5200
Stratigraphy
Ordovician, Cincinnatian Series, nomenclature, southeastern: Brown, George D., Jr. 5406
Ordovician, Saluda Formation: Hatfield, Craig Bond. 5208
Industrial minerals
Tennessee
Clam shells, reagent grade $CaCO_3$: Nelson, D. J. 5190
Insecta
Permian
Kansas, Wellington Shale, list: Moore, Raymond C. 5173
Kansas–Oklahoma, Wellington Formation, cyclic occurrence: Tasch, Paul. 5399
Invertebrata
Devonian
Pennsylvania, Mahantango Formation: Ellison, Robert L. 5293
Iron
Geochemistry
Oxide minerals: Lister, Gordon F. 5410
Lake Superior region
Geochemistry, composition: Mancuso, J. J. 5147
Minnesota
Biwabik Iron Formation, composition: Lepp, Henry. 5286
Isotopes
Analysis
Deep-sea sediments, thorium, methods: Antal, Paul S. 5359
Connate waters
Fractionation, O-18 and deuterium: Graf, Donald L. 5392
Lead
Analysis, methods, for geochronology: Baadsgaard, H. 5245
Thorium
Sediments, diagenesis in deep-sea: Antal, Paul S. 5359
Jurassic
Canada
Western, Eastern and Western Cordillera and Plains regions: Springer, G. D. 5349
Kansas
Geochemistry
Atchison region, Plattsmouth Limestone Member, compositional variance: Galle, O. Karmie. 5243
Maps
Isopach, Florena Shale, Permian: Imbrie, John. 5167
Kansas
Paleontology
Insecta and Branchiopoda, Permian, Wellington Formation, cyclic occurrence: Tasch, Paul. 5399
Pennsylvanian–Permian assemblages, repetition: Moore, Raymond C. 5173
Stratigraphy
Paleozoic, late, megacycles, sea depth, fossil evidence: Elias, Maxim K. 5161
Paleozoic, upper, cyclothems and water depth: McCrone, Alistair W. 5171
Pennsylvanian and Permian, cyclothems, paleoecology: Moore, Raymond C. 5173
Pennsylvanian, Lansing and Kansas City Groups, southeastern, cyclic patterns: Harbaugh, John W. 5166
Pennsylvanian, Tonganoxie Member of Stranger Formation, laminations: Hamblin, W. K. 5164
Pennsylvanian, Wilson County, megacyclothems: Wagner, Holly C. 5183
Permian, Wellington Formation, periodicity: Tasch, Paul. 5399
Structural geology
Trend-surface analysis: Merriam, Daniel F. 5006
Kentucky
Economic geology
Clay and gravel, Farmington quadrangle: Finch, Warren I. 5237
Coal and other mineral resources, Bruin quadrangle: Englund, Kenneth J. 5251
Coal and other mineral resources, Sandy Hook quadrangle: Englund, Kenneth J. 5144
Coal, Ketchen quadrangle: Englund, Kenneth J. 5411
Mineral resources, Howardstown quadrangle: Kepferle, Roy C. 5140
Mineral resources, New Haven quadrangle: Peterson, Warren L. 5141
Natural gas, western, underground storage, well logging application: Brown, J. A. 5222
Petroleum and natural gas, northeastern, Knox Dolomite, possibilities: McGuire, William H. 5195
Petroleum and natural gas, western, exploration and discoveries 1963–64: Rose, William D. 5194
Petroleum and natural gas, western, reservoirs, relation to gravity anomalies: McGuire, William H. 5013
Gravity surveys
Western, relation of Bouguer anomalies to oil and gas reservoirs: McGuire, William H. 5013
Maps
Geologic, Bruin quadrangle: Englund, Kenneth J. 5251
Geologic, Farmington quadrangle: Finch, Warren I. 5237

Kentucky
Maps
Geologic, Howardstown quadrangle: Kepferle, Roy C. 5140
Geologic, Ketchen quadrangle: Englund, Kenneth J. 5411
Geologic, New Haven quadrangle: Peterson, Warren L. 5141
Geologic, Sandy Hook quadrangle: Englund, Kenneth J. 5144
Stratigraphy
Carboniferous and Quaternary, Bruin quadrangle, section: Englund, Kenneth J. 5251
Carboniferous and Quaternary, Ketchen quadrangle, nomenclature: Englund, Kenneth J. 5411
Carboniferous and Quaternary, Sandy Hook quadrangle, section: Englund, Kenneth J. 5144
Ordovician, Saluda Formation: Hatfield, Craig Bond. 5208
Ordovician–Mississippian, Quaternary, Howardstown quadrangle, section: Kepferle, Roy C. 5140
Ordovician–Mississippian, Quaternary, New Haven quadrangle, section: Peterson, Warren L. 5141
Tertiary–Quaternary, Earmington quadrangle, section: Finch, Warren I. 5237
Lake Superior region
Economic geology
Iron formation, silica content: Mancuso, J. J. 5147
Stratigraphy
Precambrian: Wilson, M. E. 5385
Lakes
Genesis
Texas, High Plains, formation of basins: Reeves, C. C., Jr. 5033
Lakes, extinct
Illinois
Glacial Lake Douglas: Gardiner, M. J. 5005
Wyoming
Rock Springs uplift area, Tertiary: Roehler, Henry W. 5076
Landforms
Canada
Western, Quaternary modifications: Barton, Robert H. 5021
Laterites
West Indies
Martinique: Grunevald, Henri. 5278
Lava
Structures
Washington, Grand Coulee area, Columbia River basalts, jointing: Lefebvre, Richard H. 5101
Limestone
California
Victorville area, Oro Grande Series, resources: Bowen, Oliver E., Jr. 5398
General
Textbook, geochemistry and technology of use: Boynton, Robert S. 5378
Limestone
Kansas
Atchison region, Plattsmouth Member of Oread Limestone, geochemistry: Galle, O. Karmie. 5243
Texas
Resources and production, Lower Cretaceous sources: Rodda, Peter U. 5119
Loess
Weathering
Illinois, Douglas County: Gardiner, M. J. 5005
Louisiana
Hydrogeology
Lake Pontchartrain area, fresh water availability: Cardwell, G. T. 5275
Rapides Parish, Miocene and Pleistocene aquifers: Newcome, Roy, Jr. 5276
Sedimentary petrology
Barataria Bay, sediments, factor analysis: Klovan, J. E. 5028
Magmas
Differentiation
Anorthosite–mangerite suites: Philpotts, A. R. 5269
Greenland, Gardar rift zone intrusives: Sorensen, Henning. 5386
Primary, phase equilibria study: Bailey, D. K. 5268
Magnetic field, Earth
Maps
Grid variation, epoch 1965.0, Arctic: U.S. Coast and Geodetic Survey. 5124
Horizontal intensity, epoch 1965.0, Arctic: U.S. Coast and Geodetic Survey. 5121
Inclination, epoch 1965.0, Arctic: U.S. Coast and Geodetic Survey. 5120
Total intensity, epoch 1965.0, Arctic: U.S. Coast and Geodetic Survey. 5123
Variation, epoch 1965.0, Arctic: U.S. Coast and Geodetic Survey. 5335
Variation, epoch 1965.0, world: U.S. Coast and Geodetic Survey. 5334
Vertical intensity of magnetic force, epoch 1965.0, Arctic: U.S. Coast and Geodetic Survey. 5122
Magnetic properties
Measurements
California, Recent basalt, magnetization scatter: James, David E. 5308
New Mexico, Valles Caldera: Doell, Richard R. 5401
Magnetic surveys
Colorado
Jefferson area: Yacoub, Nazieh K. 5014
Gulf of Mexico
Anomalies: Heirtzler, J. R. 5394
Washington
Puget Sound, 1965 earthquake epicenter: Kaarsberg, Ernest A. 5093
Maine
Petrology
Pelitic schist, sillimanite–potash feldspar isograd: Evans, Bernard W. 5367

Major-element analyses
Feldspar
Maine, pelitic schist: Evans, Bernard W. 5367
Garnet
Maine, pelitic schist: Evans, Bernard W. 5367
Ground water
Utah, hot springs: Heylmun, Edgar B. 5298
Ilmenite
Maine, pelitic schist: Evans, Bernard W. 5367
Iron formation
Minnesota: Lepp, Henry. 5286
Iron-titanium minerals
North America: Lister, Gordon F. 5410
Limestone
Kansas, variance: Galle, O. Karmie. 5243
Mica
Maine, pelitic schist: Evans, Bernard W. 5367
Phillipsite
Oregon, Tertiary lake beds: Regis, A. J. 4997
Rocks and rock-minerals
New Hampshire, chemical: Billings, Marland P. 5336
Shattuckite
Proof of formula: Mrose, Mary E. 5325
Mammalia
Evolution
Middle ear, path of chorda tympani, reptilian origin: Fox, Richard C. 5294
Felidae
Quaternary, Florida, Pleistocene: Kurten, Bjorn. 5244
Primates
Evolution, textbook: Buettner-Janusch, John. 5377
Quaternary
Texas, Pleistocene clay, Houston area, Sims Bayou: Slaughter, Bob H. 5382
Tertiary
Wyoming, Eocene faunas, early: Gazin, C. Lewis. 5081
Man, fossil
Evolution
Textbook: Brace, C. L. 5374
Textbook: Buettner-Janusch, John. 5377
Textbook: Olson, Everett C. 5114
General
Archeological dating and exploration, methods, review: Rainey, Froelich. 5136
North America
Earliest arrival, artifact evidence, dating: Willey, Gordon R. 5137
Manitoba
Absolute age
Precambrian basement rock: Peterman, Z. E. 5055
Mantle
Physical properties
Seismic wave velocities, southeastern U.S.: Werth, Glenn. 5279
Shear strength, upper, reduction and earthquake origin: Riecker, R. E. 5106
Temperature
Radioactive heat and convection currents: Hess, H. H. 5267
Marine geology
Atlantic Ocean
Puerto Rico Trench, stratigraphy and petrology: Bowin, C. O. 5306
Bottom features
Atlantic Coastal Plain, submarine canyons: White, William A. 5304
Oregon
Continental terrace, central coast: Maloney, Neil Joseph. 5210
Maryland
Absolute age
Metamorphic and igneous rocks: Wetherill, G. W. 5364
Massachusetts
Geomorphology
Paleo-stream flow regime, interpretation: Jopling, Alan V. 5352
Glacial geology
Greenfield quadrangle, features: Jahns, Richard H. 5112
Paleo-stream flow regime, interpretation: Jopling, Alan V. 5352
Maps
Geologic, Greenfield quadrangle, surficial: Jahns, Richard H. 5112
Mesozoic
California
Mount Hamilton quadrangle, Isabel-Eylar area, Franciscan Formation: Soliman, Soliman M. 5389
Oroville quadrangle, stratigraphy and deformation: Creely, Robert Scott. 5396
Cuba
Tectonic and depositional history: Furrazola-Bermudez, Gustavo. 5338
Metals
Alaska
Southeastern, exploration: Herbert, C. F. 5413
Taylor Highway region, geochemical prospecting: Saunders, R. H. 5260
California
Victorville area, gold, silver, copper, lead: Bowen, Oliver E., Jr. 5398
Montana
Flathead-Lincoln Counties, geochemical prospecting: Sahinen, U. M. 5395
Production
Minor metals, supply and competition: Brooks, David B. 5319
Metamorphic rocks
General
Geochemistry, analyses, New Hampshire: Billings, Marland P. 5336
Mineral assemblages
British Columbia, Vancouver North, Coquitlam, Pitt Lake map-areas, evolution: Roddick, J. A. 5366
Greenschist facies, experimental: Hellner, E. 5329
Maine, pelitic schist, sillimanite-orthoclase isograd: Evans, Bernard W. 5367

Metamorphic rocks
Schist
Mineral composition, sillimanite–orthoclase isograd, Maine: Evans, Bernard W. 5367
Metamorphism
Migration of elements
Diffusion in a pressure gradient: Gresens, Randall L. 5355
Progressive
Greenschist facies rocks: Hellner, E. 5329
P–T conditions
Pressure differences prediction, elastic theory, ruby nodules: Giardini, A. A. 5092
Sillimanite–potash feldspar isograd, Maine, pelitic schist: Evans, Bernard W. 5367
Regional
Maine, pelitic schist, Sill–Or–Ms–Plag–Q assemblage: Evans, Bernard W. 5367
Retrograde
British Columbia, Vancouver North–Coquitlam–Pitt Lake map–areas: Roddick, J. A. 5366
Meteorites
Age
Cosmic–ray exposure, argon isotopes: Cobb, James C. 5223
Mexico
Absolute age
C–14, list, 1962–64, determinations: Valencia, Josefina. 5266
Metamorphic and igneous rocks, determinations since 1962: Fries, Carl, Jr. 5418
General
Research, 1964, Mexico University Institute of Geology: Salas, Guillermo P. 5246
Mineralogy
Clay minerals, Pacific Coast, northern: delaTorre, Jorge. 5281
Michigan
Sedimentary petrology
Lucas Formation, anhydrite, textures: Haney, Warren D. 5165
Stratigraphy
Devonian, Lucas Formation, evaporitic cycles: Haney, Warren D. 5165
Micropaleontology
Classification
Protista, hystrichospheres, Acritarcha, new subgroups and genera: Staplin, Frank L. 5362
Cretaceous
Texas, Albian, Merrill's sponge spicules reexamined: Sarjeant, William A. S. 5417
Mesozoic
Northwest Territories, Deer Bay Formation, Franklin: Yorath, C. J. 5043
Mineral data
Acanthite
Biogenic: MacDiarmid, Roy A. 5357
Actinolite
Synthetic, stability: Hellner, E. 5329
Amphibole
Synthetic, stability: Hellner, E. 5329
Mineral data
Apatite
Carbonate type, synthetic, CO_3 effect on cell dimensions: Zapanta–LeGeros, Racquel. 5328
Aragonite
Conversion to calcite, Mg ion effect on rate: McLaren, Eugene. 4991
Binnite
Crystal structure: Wuensch, B. J. 5003
Bonattite
Cell parameters and crystal structure: Zahrobsky, R. 5004
Clino–anthophyllite
Calcium deficient lamellae in tremolite, new polymorph: Bowa, M. G. 5069
Clinohumite
Composition, optical properties: Salotti, Charles A. 5000
Diamond
Reaction with boron: Dickinson, S. K., Jr. 5073
Epistilbite
Cell parameters and crystal structure: 'Kane, W. T. 4988
Feldspar
Northwest Territories, Muskox intrusion, composition and distribution: Pouliot, G. 4994
Hypersthene
Pleochroism, origin: Burns, Roger G. 5071
K–feldspar
Al–Si order–disorder relations: Dietrich, R. V. 4985
Larsenite
Crystal structure, refinement: Prewitt, C. T. 4996
Laueite
Crystal structure: Moore, Paul B. 5065
Lorandite
Crystal structure refinement: Knowles, Charles R. 4989
Manganese minerals
Trace elements, crystal chemistry in sea–floor nodules: Burns, Roger G. 5327
Melanophlogite
Crystal structure: Appleman, Daniel E. 5067
Metastrengite
Crystal structure: Moore, Paul B. 5065
Mica
Composition, neutron activation analysis, technique: Eichholz, G. G. 5099
Mizzonite
Crystal structure: Papike, J. J. 4992
Phillipsite
Oregon, Tertiary lake beds, properties: Regis, A. J. 4997
Rhodizite
Crystal structure and chemical formula: Buerger, Martin K. 5390
Shattuckite
Formula, proof, and physical properties: Mrose, Mary E. 5325

Mineral data
Silicates
Atomic thermal parameters: Burnham, Charles W. 5070
Optical absorption spectra, low iron content type: White, William B. 5322
Silver tellurides
Melting and transition temperatures: Kracek, F. C. 4990
Sulfates
Infrared spectroscopy, interpretation: Adler, Hans H. 5066
Tetrahedrite
Crystal structure: Wuensch, B. J. 5003
Tremolite
Intergrowth with clino anthophyllite: Bown, M. G. 5069
Tremolite–ferroactinolite series
Synthetic: Hellner, E. 5329
Tsumebite
Crystal structure and composition: Nichols, M. C. 5324
Structure and geochemistry: Bideaux, R. A. 5068
Vonsenite
California, Monterey County; Chesterman, Charles W. 5072
Mineral deposits, genesis
Igneous processes
Fe–Ti oxides: Lister, Gordon F. 5410
Ni–pyrrhotite ores: Desborough, George A. 5146
Iron
Minnesota, Mesabi Range: Lepp, Henry. 5286
Phosphate
Atlantic Coastal Plain: Pevear, D. R. 5409
Uranium
Colorado, Schwartzwalder mine: Downs, George R. 5422
Mineral economics
Continental shelf
Resources, development legislation: Ely, Northcutt. 5102
Minor metals
Supply and competition: Brooks, David B. 5319
Resources
Future, supplies for teeming world: Just, Evan. 5105
Technological developments
Impact on geology and mining, ocean problems: Wolfe, John A. 5104
Thorium
Canada, Elliot Lake: Griffith, J. W. 5158
Resources and availability for nuclear power, 1964–2000: Faulkner, R. L. 5412
Uranium
Canada, Elliot Lake: Griffith, J. W. 5158
Resources and availability for nuclear power, 1964–2000: Faulkner, R. L. 5412
Mineral exploration
Geophysical methods
Fundamentals and future evolution of techniques: Brant, Arthur A. 5339
Mineral exploration
Ore guides
Sandstone, uranium, zoning in relation to tectonic belts: Nininger, R. D. 5404
Mineral resources
Abundance
Future in relation to expanding economy: Just, Evan. 5105
Canada
Western, distribution, summary: Nelson, S. J. 5346
Production
Technological developments, impact, ocean problems: Wolfe, John A. 5104
Mineral zoning
Uranium
Sandstone deposits, relation to tectonic zone: Nininger, R. D. 5404
Mineralogy
Composition
Micas, neutron activation analysis, slow and fast: Eichholz, G. G. 5099
Identification techniques
Polytypes by vector relations: Ross, M. 4999
Mining geology
Reserves computation
Principles, methods: Popoff, Constantine C. 5225
Technology
New developments, impact on mineral economics, ocean problems: Wolfe, John A. 5104
Minnesota
Economic geology
Iron, Mesabi Range: Lepp, Henry. 5286
Geochemistry
Duluth Gabbro, Fe–Ti oxides: Lister, Gordon F. 5410
Sedimentary petrology
Northeastern, Rove Formation: Morey, Glenn Bernhardt. 5213
Stratigraphy
Precambrian, Rove Formation, northeastern: Morey, Glenn Bernhardt. 5213
Mississippi
Absolute age
Meridian Sand, muscovite: Wermund, E. G. 5309
Mississippi Valley
Sedimentary petrology
Upper, pre–Cincinnatian Paleozoic, lithotopes: Ostrom, Meredith Eggers. 5174
Stratigraphy
Ordovician, Prairie du Chien Group, revision: Davis, Richard A., Jr. 5008
Paleozoic, pre–Cincinnatian, cyclic patterns: Ostrom, Meredith Eggers. 5174
Mississippian
Alabama
Northwestern, Floyd–Parkwood sequence, correlation with Ouachita geosyncline: Thomas, William A. 5148

Mississippian
Alberta
Highwood River area, Mount Head and Livingstone Formations: Nielsen, Grant L. 5040
Alberta–British Columbia
Flathead map-area, stratigraphy: Price, R. A. 5287
Canada
Western, Anthozoa, Banff Formation and Rundle Group: Bamber, E. W. 5416
Newfoundland
Codroy Valley, stratigraphy: Utting, J. 5230
Pennsylvania
Altoona–Gallitzin area, stratigraphy: Swartz, Frank M. 5370
Somerset County, stratigraphy: Flint, Norman K. 5383

Missouri
Glacial geology
Saint Louis area, deposits and drainage: Goodfield, Alan Granger. 5316

Mohorovicic discontinuity
General
Mississippi, southward dip: Werth, Glenn. 5279

Mollusca
Cretaceous
South Dakota, Fox Hills Formation, concretion layers: Waage, Karl M. 5182

Montana
General
Bibliography, unpublished geologic studies: Chelini, J. M. 5317
Geochemistry
Flathead–Lincoln Counties, geochemical prospecting: Sahinen, U. M. 5395
Maps
Geochemical, heavy metals, Flathead–Lincoln Counties, sediments: Sahinen, U. M. 5395
Geologic, Flint Creek Range: Allen, Jack C., Jr. 5307
Paleontology
Palynomorphs, Cretaceous, Shawmut anticline: Melchior, Robert Charles. 5211
Petrology
Flint Creek Range, Royal stock: Allen, Jack C., Jr. 5307
Structural geology
Flint Creek Range, intrusion: Allen, Jack C., Jr. 5307

Nebraska
Stratigraphy
Pennsylvanian, sequences, relation to megacyclothems: Reed, E. C. 5177

Nevada
Maps
Geologic, Kern Mts. and northern Snake Range: Nelson, Robert B. 5155
Paleontology
Conodonts, Devonian, biostratigraphy: Clark, D. L. 5199

Nevada
Petrology
Rhizoconcretions in vitric ash fall tuff: Luft, Stanley J. 5369
Stratigraphy
Devonian, time lines from conodont assemblages: Clark, D. L. 5199
Pennsylvanian–Permian, cyclic patterns, Great Basin: Bissell, H. J. 5341
Triassic, Spring Mts., repetitive sequence: Larson, Allan R. 5170
Structural geology
White Pine County, Kern Mts., Snake Range: Nelson, Robert B. 5155

New Hampshire
Geochemistry
Rocks and rock minerals, major and trace-element analyses: Billings, Marland P. 5336

New Jersey
Geomorphology
Sandy Hook, Atlantic Coast, beach, cyclic tidal changes: Strahler, Arthur N. 5031
Maps
Geologic, general: Yolton, James S. 5240
Radioactivity, Frenchtown quadrangle, airborne: Boynton, G. R. 5235
Radioactivity, Pittstown High Bridge quadrangles, airborne: Boynton, G. R. 5234
Paleontology
Collecting guide: Yolton, James S. 5240
Sedimentary petrology
Central, Lockatong Formation: VanHouten, Franklyn B. 5180
Stratigraphy
Triassic, Lockatong Formation, central: VanHouten, Franklyn B. 5180

New Mexico
Absolute age
Valles Caldera, rhyolite: Doell, Richard R. 5401
Areal geology
Mountains, guide: Ungnade, Herbert E. 5228
Geothermal energy
Resources, review: Summers, W. K. 5297
Maps
Geologic, San Lucas Dam quadrangle: Santos, Elmer S. 5111
Thermal springs and wells in Quaternary and Tertiary igneous rocks: Summers, W. K. 5297
Paleomagnetism
Valles Caldera, field reversals: Doell, Richard R. 5401
Sedimentary petrology
Rio Grande sediments, heavy mineral suites, statistical methods: Young, Edward J. 5025
San Juan Basin, Cretaceous, criteria for depositional environments: Sabins, Floyd F., Jr. 5226
Stratigraphy
Cretaceous, Dakota Sandstone, nomenclature, San Juan basin: Owen, D. E. 5157
Cretaceous, San Juan Basin, cycles: Sabins, Floyd F., Jr. 5226

New Mexico
Stratigraphy
Permian, Castile Formation, intrabasin varve correlation, southeastern: Anderson, Roger Y. 5305
New York
Paleontology
Foraminifera, Quaternary, Long Island Sound, *Elphidium* groups: Buzas, M. A. 5363
Petrology
Adirondack Mts., Precambrian rocks: Wilson, M. E. 5385
Glens Falls and Fort Ann quadrangles, Precambrian rocks: Hills, Francis Allan. 5421
Sedimentary petrology
Keuka Lake area, Bluff Point Siltstone, sedimentary structure orientation: Sutton, Robert G. 5029
Long Island Sound sediments: McCrone, A. W. 5129
Normanskill Formation, fabric of turbidite graywackes: Smoor, Peter Bernard. 5323
Newfoundland
Areal geology
Bay of Islands area: Weitz, Joseph Leonard. 5220
Stratigraphy
Carboniferous, Codroy Valley: Utting, J. 5230
Nickel
Geochemistry
Distribution in sulfide deposits, Saskatchewan, Flin Flon area: Faulkner, Edward Leslie. 5420
Ni pyrrhotite ores: Desborough, George A. 5146
North America
Maps
Magnetic, variation, epoch 1965.0, world: U.S. Coast and Geodetic Survey. 5334
Paleontology
Man, fossil, earliest arrival: Willey, Gordon R. 5137
Ostracoda, Ordovician, kloedenellacean and lomatopisthian, dimorphism: Guber, Albert L. 5134
Stratigraphy
Craton, sequences, tectonic interpretations: Sloss, L. L. 5178
Structural geology
Craton, tectonic activity, stratigraphic sequences: Sloss, L. L. 5178
North Carolina
Geomorphology
Coastal plain, drainage pattern and capes: White, William A. 5304
Maps
Aeromagnetic, Mount Pleasant–Albermarle–Denton–Salisbury quadrangles: Henderson, John R. 5233
Gravity, Mount Pleasant, Albemarle, Denton, Salisbury quadrangles, Bouguer: Watkins, J. S. 5115
North Carolina
Seismic surveys
Troy area, anomalous high velocity: Husted, John E. 5097
Northwest Territories
Economic geology
Metals and uranium, Eldorado mine, mineralogy: Kieller, B. J. 5057
Glacial geology
Baffin Island, Isortoq Valley, moraines, types, genesis: Andrews, J. T. 5037
Maps
Aeromagnetic, Keewatin, Baker Foreland area: Canada Geological Survey. 5446
Aeromagnetic, Keewatin, Banks Lake East area: Canada Geological Survey. 5450
Aeromagnetic, Keewatin, Banks Lake West area: Canada Geological Survey. 5449
Aeromagnetic, Keewatin, Big Willow Bay area: Canada Geological Survey. 5467
Aeromagnetic, Keewatin, Cape Jones area: Canada Geological Survey. 5443
Aeromagnetic, Keewatin, Chesterfield Inlet area: Canada Geological Survey. 5468
Aeromagnetic, Keewatin, Gibson Lake South area: Canada Geological Survey. 5463
Aeromagnetic, Keewatin, Kaminuriak Lake North area: Canada Geological Survey. 5447
Aeromagnetic, Keewatin, MacQuoid Lake area: Canada Geological Survey. 5460
Aeromagnetic, Keewatin, McManaman Lake area: Canada Geological Survey. 5465
Aeromagnetic, Keewatin, Meliadine Lake area: Canada Geological Survey. 5454
Aeromagnetic, Keewatin, Pangertot Peninsula area: Canada Geological Survey. 5442
Aeromagnetic, Keewatin, Parker Lake South area: Canada Geological Survey. 5459
Aeromagnetic, Keewatin, Peter Lake area: Canada Geological Survey. 5453
Aeromagnetic, Keewatin, Rabbit Island area: Canada Geological Survey. 5445
Aeromagnetic, Keewatin, Sheet 55 E/2: Canada Geological Survey. 5441
Aeromagnetic, Keewatin, Sheet 55 M/E3: Canada Geological Survey. 5448
Aeromagnetic, Keewatin, Sheet 55 M/S5: Canada Geological Survey. 5458
Aeromagnetic, Keewatin, Sheet 55 M/8: Canada Geological Survey. 5461
Aeromagnetic, Keewatin, Sheet 55 N/4: Canada Geological Survey. 5451
Aeromagnetic, Keewatin, Sheet 55 N/3: Canada Geological Survey. 5452
Aeromagnetic, Keewatin, Sheet 55 N/5: Canada Geological Survey. 5462
Aeromagnetic, Keewatin, Sheet 55 N/7: Canada Geological Survey. 5464
Aeromagnetic, Keewatin, Sheet 55 O/T4: Canada Geological Survey. 5455
Aeromagnetic, Keewatin, Sheet 55 O/E3: Canada Geological Survey. 5456
Aeromagnetic, Keewatin, Sheet 55 O/T2: Canada Geological Survey. 5457

Northwest Territories
Maps
Aeromagnetic, Keewatin, Sheet 55 O/ 5: Canada Geological Survey. 5466
Aeromagnetic, Keewatin, Thomson Island area: Canada Geological Survey. 5444
Mineralogy
Plagioclase and alkali-feldspar, Muskox intrusion, compositional distribution: Pouliot, G. 4994
Port Radium, Eldorado mine: Kieller, B. J. 5057
Paleontology
Microfauna, Mesozoic, Deer Bay Formation, Franklin: Yorath, C. J. 5043
Nuclear explosions
Applications
PLOWSHARE program, significance in engineering: Johnson, G. W. 5408
Elastic waves
S waves, parameters: DeNoyer, J. M. 5414
Seismic effects
Elastic waves, cavity environment: Lewis, H. W. 5303
Source motions
Automatic data processing: Holzer, F. 5261
Ohio
Geophysical surveys
Central and western, radioactivity, airborne: Bates, Robert G. 5151
Maps
Radioactivity, central and western, airborne: Bates, Robert G. 5151
Paleontology
Fossils, problematic, Ordovician, Cincinnatian Series: Osgood, Richard Grosvenor, Jr. 5214
Pisces, Devonian, Cleveland Shale, Cleveland area: Hlavin, W. J. 5296
Stratigraphy
Ordovician, Saluda Formation: Hatfield, Craig Bond. 5208
Oil and gas fields
Florida
Sunoco-Felda field, map: Florida Division of Geology. 5113
Wyoming
West Moorcroft Dakota oil field: Mettler, Don E. 5258
Oil shale
Wyoming
Green River Formation, resources: Smith, John Ward. 5080
Oklahoma
Paleontology
Insecta and Branchiopoda, Permian, Wellington Formation, cyclic occurrence: Tasch, Paul. 5399
Vertebrata, Permian, Chickasha Formation, Blaine-Grady Counties: Olson, Everett C. 5247
Stratigraphy
Paleozoic, upper, cyclic patterns: Branson, Carl C. 5159
Oklahoma
Stratigraphy
Pennsylvanian, Tallant and Vamoosa Formations, laminations: Hamblin, W. K. 5164
Permian, Chickasha Formation, Blaine-Stephens Counties: Olson, Everett C. 5247
Permian, Wellington Formation, periodicity: Tasch, Paul. 5399
Ontario
Electrical surveys
Big Creek region, ground-water resources: Wessels, Gerhardus J. M. 5388
Geochemistry
General, Fe-Ti oxides: Lister, Gordon F. 5410
Glacial geology
Dundas Valley, drift, relation to Great Lake stages: Hurst, Donald Lindsay. 5046
Hydrogeology
Big Creek region, electrical surveys for aquifers: Wessels, Gerhardus J. M. 5388
Sedimentary petrology
Hamilton area, Gasport Dolomite, depositional environment: Spurgeon, Ernest S. 5050
Lake Erie shore, Long Point, beach sands: Watts, Terence Roger. 5047
Stratigraphy
Niagara escarpment, Whirlpool Sandstone, provenance: Gietz, Otto. 5051
Optical mineralogy
Pleochroism
Hypersthene, origin: Burns, Roger G. 5071
Ordovician
Alaska
Tatonduk River area, Brachiopoda: Ross, Reuben James, Jr. 5135
Canada
Western Plains, Winnipeg and Bighorn Groups, Cordilleran equivalents: Porter, J. W. 5015
Indiana
Saluda Formation: Hatfield, Craig Bond. 5208
Southeastern, Cincinnatian Series, nomenclature, new: Brown, George D., Jr. 5406
Kentucky
Saluda Formation: Hatfield, Craig Bond. 5208
Mississippi Valley
Pre-Cincinnatian, cyclic patterns and lithotopes: Ostrom, Meredith Eggers. 5174
Upper, Prairie du Chien Group, revision: Davis, Richard A., Jr. 5008
North America
Ostracoda, kloedenellacean and lomatopisthian, dimorphism: Guber, Albert L. 5134

Ordovician
Ohio
Saluda Formation: Hatfield, Craig Bond. 5208
Oregon
Absolute age
Cape Blanco, Pleistocene marine shells: Richards, Horace G. 5387
Summer Lake, pumice: Allison, Ira S. 5311
Areal geology
Continental terrace, central coast: Maloney, Neil Joseph. 5210
Economic geology
Petroleum and natural gas, exploration: Stewart, R. E. 5379
Maps
Oil and gas, drilling, 1965: Stewart, R. E. 5379
Mineralogy
Phillipsite, Crooked Creek, Tertiary lake beds: Regis, A. J. 4997
Paleontology
Mollusca, Oligocene–Pliocene, coastal, n. sp.: Addicott, W. O. 5299
Sedimentary petrology
Coast Range, Tyee Formation: Snavely, Parke D., Jr. 5179
Stratigraphy
Quaternary, sandy-pumice layer, correlation, Summer Lake: Allison, Ira S. 5311
Tertiary, Tyee Formation, Coast Range, rhythmic bedding: Snavely, Parke D., Jr. 5179
Organic materials
Amino acids
Thermal stability, Miocene and Recent sediments: Sellers, George August. 5217
Bitumens
Geochemical evolution, role of radioactivity: Colombo, U. 5145
Hydrocarbons
Disposition in rock systems, significance: Zarrella, William M. 5423
Geochemical evolution, role of radioactivity: Colombo, U. 5145
Orogeny
Hudsonian
Saskatchewan and Manitoba, effect on Precambrian basement: Peterman, Z. E. 5055
Ostracoda
Kloedenellacea
Ordovician, North America, dimorphism, classification and nomenclature: Guber, Albert L. 5134
Lomatopisthiidae, n. fam.
Ordovician, North America, dimorphism, classification and nomenclature: Guber, Albert L. 5134
Monotiopleuridae, n. fam.
Ordovician, North America, dimorphism, classification and nomenclature: Guber, Albert L. 5134
Ostracoda
Taxonomy
Lectotype designation for new species 1959–1964: Benson, R. H. 5196
Tertiary
Caribbean region, *Procythereis* cf. *deformis* and *Mutilus confragosus* zones: Bold, W. A. van den. 5011
Trinidad, Springvale and Manzanilla Formations, Miocene, correlation: Bold, W. A. van den. 5361
Pacific Ocean
Absolute age
Deep-sea sediments: Dymond, Jack R. 5224
Paleobotany
Environmental analysis
Angiosperms, Cretaceous–Recent: Axelrod, Daniel I. 5270
Tertiary, Georgia, Paleocene–Eocene, Adairsville area: Stanley, Edward A. 5090
Paleoclimatology
Cretaceous
Wyoming, faunal indicators: Ostrom, John H. 5330
Quaternary
California, Soboba flora, Riverside County: Axelrod, Daniel I. 5284
Texas, relation to formation of lake basins: Reeves, C. C., Jr. 5033
Temperatures
Cretaceous–Recent, angiosperm adaptation: Axelrod, Daniel I. 5270
Triassic
Pennsylvania, Lockatong Formation, cyclic lacustrine beds: VanHouten, Franklyn B. 5180
Paleoecology
Angiosperms
Cretaceous–Recent, deciduous and evergreen habits: Axelrod, Daniel I. 5270
Foraminifera
Cretaceous, marine, Colorado, Pueblo area, Carlile Shale: Eicher, Don L. 5295
Indicators
Elemental composition of siderite nodules in argillaceous rocks: Weber, Jon N. 5041
Fossil orientation and distribution: Toots, Heinrich. 5088
Ophiomorpha, Cretaceous, U.S., shallow marine: Hoyt, John H. 5086
Mammalia
Tertiary, early, Wyoming, southwestern: Gazin, C. Lewis. 5081
Pennsylvanian–Permian
Ecosystems, Kansas: Moore, Raymond C. 5173
Quaternary
Terrestrial, California, Soboba flora, Riverside County: Axelrod, Daniel I. 5284
Tertiary
Lacustrine, Wyoming, lower Eocene: Roehler, Henry W. 5076
Vertebrate
Cretaceous, fluvial to terrestrial, Wyoming: Ostrom, John H. 5330

Paleogeography
Colorado
Pennsylvanian and Permian: DeVoto, Richard H. 5250
Devonian
Canada, western, Elk Point Group: Grayston, L. D. 5016
Tennessee, Flynn Creek structure area: Roddy, David J. 4998
Jurassic
Canada, western: Springer, G. D. 5349
Reconstruction
Fossil orientation and distribution: Toots, Heinrich. 5088
Tertiary
Wyoming, Rock Springs uplift area, early: Roehler, Henry W. 5076
Triassic
Canada, western: Barss, D. L. 5019
Paleomagnetism
Applications
Scatter of remanent magnetization, Recent basalt: James, David E. 5308
Reversals
Polarity evidence, Valles Caldera, New Mexico: Doell, Richard R. 5401
Paleontology
Collecting
New Jersey guide: Yolton, James S. 5240
Life, origin
Role of atmosphere and sea: Wald, George. 5368
Methods
Environment reconstruction, fossil orientation and distribution: Toots, Heinrich. 5088
Paleozoic
Canada
Western, formation fluids, geochemistry, regional variations: Hitchon, Brian. 5022
Kansas
Late, megacycles, sea depth, fossil evidence: Elias, Maxim K. 5161
Nevada
White Pine County, stratigraphy: Nelson, Robert B. 5155
Utah
Beaver County, stratigraphy: East, Edwin H. 5154
Juab County, stratigraphy: Nelson, Robert B. 5155
Wah Wah Mountains, stratigraphy: Miller, Gerald M. 5153
Palynology
Cretaceous
Montana, Shawmut anticline: Melchior, Robert Charles. 5211
Tertiary
Georgia, Paleocene–Eocene, Adairsville area: Stanley, Edward A. 5090
Pelecypoda
Tertiary
Oregon–Washington, Oligocene–Pliocene, n. sp.: Addicott, W. O. 5299
Pennsylvania
Economic geology
Coal, clay, sandstone, Somerset County: Flint, Norman K. 5383
Maps
Geologic, mineral resources, and isopach, Somerset County: Flint, Norman K. 5383
Radioactivity, Riegelsville quadrangle, part, airborne: Boynton, G. R. 5235
Paleontology
Fauna and flora, Devonian–Pennsylvanian, Altoona–Gallitzin area, guidebook: Swartz, Frank M. 5370
Invertebrata, Devonian, Mahantango Formation, south-central: Ellison, Robert L. 5293
Sedimentary petrology
Southeastern, Lockatong Formation: VanHouten, Franklyn B. 5180
Stratigraphy
Devonian, Mahantango Formation, south-central: Ellison, Robert L. 5293
Devonian–Pennsylvanian, Altoona–Gallitzin area, guidebook: Swartz, Frank M. 5370
Paleozoic, Somerset County, southern: Flint, Norman K. 5383
Triassic, Lockatong Formation, southeastern: VanHouten, Franklyn B. 5180
Pennsylvanian
Arizona
Central, Naco Formation: Brew, Douglas Crocker. 5203
Colorado
Central, stratigraphy: DeVoto, Richard H. 5250
Cyclic patterns: Chronic, John. 5160
Indiana
Newburg, Anthozoa: Lane, G. N. 5200
Kansas
Atchison region, Plattsmouth Limestone Member of Oread Limestone: Galle, O. Karmie. 5243
Cyclothems and repetitive fossil assemblages: Moore, Raymond C. 5173
Southeastern, Lansing and Kansas City Groups, cyclic patterns: Harbaugh, John W. 5166
Tonganoxie Member of Stranger Formation, laminations: Hamblin, W. K. 5164
Wilson County, megacyclothems: Wagner, Holly C. 5183
Nebraska
Sequences, relation to megacyclothems: Reed, E. C. 5177
Nevada
Great Basin, Ely Group, cyclic patterns: Bissell, H. J. 5341
Newfoundland
Codroy Valley, stratigraphy: Utting, J. 5230
Oklahoma
Cyclic patterns: Branson, Carl C. 5159
Tallant and Vamoosa Formations, laminations: Hamblin, W. K. 5164

Pennsylvanian
Pennsylvania
Altoona–Gallitzin area, stratigraphy: Swartz, Frank M. 5370
Somerset County, stratigraphy: Flint, Norman K. 5383
Texas
Western, stratigraphy: VanSiclen, D. C. 5181
United States
Midcontinent, northern, cyclothems and water depth: McCrone, Alistair W. 5171
Midcontinent, northern, phases and facies: Laporte, Leo F. 5169
Midwest, cyclic patterns: Wanless, Harold R. 5184
Utah
Great Basin, Ely Group, cyclic patterns: Bissell, H. J. 5341
Yukon
Mount White–Little Atlin Lake area, stratigraphy: Link, Peter Karl. 5209
Permeability
Sandstone
Fredericksburg Group, lower, Texas: Moore, C. H., Jr. 5405
Soils
Variability in layered: Kenney, T. C. 5360
Permian
Arizona
Northern, cyclic patterns, chemical deposits: McKee, Edwin D. 5172
Canada
Western, Ishbel Group, Belloy Formation, and Cache Creek Group: McGugan, A. 5018
Colorado
Central, stratigraphy: DeVoto, Richard H. 5250
Kansas
Cyclothems and repetitive fossil assemblages: Moore, Raymond C. 5173
Wellington Formation, periodicity: Tasch, Paul. 5399
Nevada
Great Basin, Arcturus–Park City Groups, cyclic patterns: Bissell, H. J. 5341
Oklahoma
Blaine–Stephens Counties, Chickasha Formation, Vertebrata: Olson, Everett C. 5247
Cyclic patterns: Branson, Carl C. 5159
Wellington Formation, periodicity: Tasch, Paul. 5399
Texas
Reptilia of Lower, *Captorhinus*: Fox, Richard C. 5320
Western, stratigraphy: VanSiclen, D. C. 5181
United States
Midcontinent, northern, Beattie Limestone: Imbrie, John. 5167
Midcontinent, northern, cyclothems and water depth: McCrone, Alistair W. 5171
Midcontinent, northern, phases and facies: Laporte, Leo F. 5169
Permian
Utah
Great Basin, Arcturus–Park City Groups, cyclic patterns: Bissell, H. J. 5341
Yukon
Mount White–Little Atlin Lake area, stratigraphy: Link, Peter Karl. 5209
Tika Creek section, Invertebrata: Cameron, B. E. B. 5045
Petrofabrics
Experimental studies
Quartz, deformation and recrystallization: Bhattacharyya, D. S. 5345
Quartz, deformation and recrystallization: Christie, J. M. 5009
Petroleum
Alberta
Upper Devonian fields: Belyea, Helen R. 5343
Canada
Western, geochemistry, regional variations: Hitchon, Brian. 5022
Exploration
Hydrocarbon disposition in rock systems, significance: Zarrella, William M. 5423
Genesis
Role of radioactivity in geochemical evolution: Colombo, U. 5145
Geochemistry
Composition, quantitative and qualitative aspects, research needs: Smith, Harold M. 5280
Regional variations, Canada, western: Hitchon, Brian. 5022
Kentucky
Northeastern, Knox Dolomite, possibilities: McGuire, William H. 5195
Western, exploration and discoveries 1963–64: Rose, William D. 5194
Western, reservoirs, relation to gravity anomalies: McGuire, William H. 5013
Oregon
Exploration: Stewart, R. E. 5379
Properties
Regional variations, Canada, western: Hitchon, Brian. 5022
Texas
Gulf Coastal Province, occurrence and production, summary: Fisher, W. L. 5291
Permeability trends, determination: Moore, C. H., Jr. 5405
Wyoming
Laramie–eastern Hanna basin area, resources: Stone, D. S. 5257
Patrick Draw field, Almond Formation: Weimer, Robert J. 5128
West Moorcroft Dakota field, structure: Mettler, Don E. 5258
Phase equilibria
Ag–Te
Temperature–composition diagram to 950°C: Kracek, F. C. 4990
$CaCO_3$
Mg ion effect on conversion of aragonite and vaterite to calcite: McLaren, Eugene. 4991

Phase equilibria
$LiAlGeO_4$
Transition between phenacite and spinel structures: Gaines, A. M. 4987
Mg–Fe–Si–O
Retrograde melting: Speidel, David H. 5187
Sodium–aluminum–iron silicate
Alkaline-rock petrogenesis: Bailey, D. K. 5268
Tremolite–ferroactinolite series
Experimental study: Hellner, E. 5329
Phosphate
Genesis
Estuarine environment: Pevear, D. R. 5409
Geochemistry
Uranium content: Habashi, Fathi. 5356
Pisces
Ctenacanthus
Mississippian, Georgia, Bangor Limestone, Dade County, dorsal fin spine: Cramer, Howard Ross. 5094
Devonian
Ohio, Cleveland area, Cleveland Shale: Hlavin, W. J. 5296
Permian
Oklahoma, Chickasha Formation, Blaine–Grady Counties, new sites: Olson, Everett C. 5247
Polymetallic ores
Alabama
Cragford area, mineralization: Neathery, Thornton L. 5149
Appalachians
Southern, cupriferous pyrrhotite deposits, mineralogy: Carpenter, Robert Heron. 5204
Popular and elementary geology
Earth
History: Simak, Clifford D. 5227
New Mexico
Mountains, guide: Ungnade, Herbert E. 5228
Solar system
Origin: Page, Thornton. 5232
Porifera
Protospongia hicksi
Cambrian, Utah, Marjum Formation, House Range: Rigby, Keith J. 5198
Precambrian
Alberta
Jasper, Wynd map-area, Miette Formation: Griffiths, R. E. 5054
Alberta–British Columbia
Flathead map-area, stratigraphy: Price, R. A. 5287
California
Death Valley, stratigraphy: Wright, Lauren A. 5191
Canada
Shield area: Wilson, M. E. 5385
Western, time-rock units: Burwash, R. A. 5010
Greenland
Stratigraphy and structure: Berthelsen, Asger. 5277
Precambrian
Lake Superior region
Stratigraphy: Wilson, M. E. 5385
Minnesota
Northeastern, Rove Formation: Morey, Glenn Bernhardt. 5213
New York
Adirondack Mts., petrology: Wilson, M. E. 5385
Glens Falls and Fort Ann quadrangles: Hills, Francis Allan. 5421
Protista
Dinoflagellates
Cretaceous, Texas, Albian, Merrill's sponge spicules reexamined: Sarjeant, William A. S. 5417
Hystrichospheres
Acritarcha, classification and nomenclature, new subgroups and genera: Staplin, Frank L. 5362
Puerto Rico
Economic geology
Gravel, resources: Gelabert, P. A. 5285
Maps
Mineral resources, sand and gravel: Gelabert, P. A. 5285
Quaternary
California
Riverside County, Soboba flora: Axelrod, Daniel I. 5284
Canada
Western, stratigraphy: Barton, Robert H. 5021
Colorado
Grand Mesa area, glaciation and stratigraphy: Yeend, Warren Ernest. 5221
Florida
Mammalia, Pleistocene, Felidae: Kurten, Bjorn. 5244
New York
Long Island Sound, Foraminifera: Buzas, M. A. 5363
North America
Man, fossil, earliest arrival: Willey, Gordon R. 5137
Texas
Houston area, Mammalia, Pleistocene clay, Sims Bayou: Slaughter, Bob H. 5382
Washington
Northwestern, Pleistocene deposits, correlation: Esterbrook, D. J. 5381
Quebec
Geochemistry
General, Fe–Ti oxides: Lister, Gordon F. 5410
Maps
Aeromagnetic, Lac a la Croix area: Canada Geological Survey. 5438
Aeromagnetic, Lac Allenou area: Canada Geological Survey. 5429
Aeromagnetic, Lac Aubin–Tellier area: Canada Geological Survey. 5439
Aeromagnetic, Lac Brue area: Canada Geological Survey. 5437

Quebec
Maps
Aeromagnetic, Lac Courtois area: Canada Geological Survey. 5431
Aeromagnetic, Lac de Sept-Milles area: Canada Geological Survey. 5433
Aeromagnetic, Lac des Deux-Milles area: Canada Geological Survey. 5426
Aeromagnetic, Lac du Cran-Casse area: Canada Geological Survey. 5436
Aeromagnetic, Lac Indicateur area: Canada Geological Survey. 5428
Aeromagnetic, Lac L'Epinay area: Canada Geological Survey. 5427
Aeromagnetic, Lac Maublant area: Canada Geological Survey. 5440
Aeromagnetic, Lac Natipi area: Canada Geological Survey. 5430
Aeromagnetic, Lac Palairet area: Canada Geological Survey. 5425
Aeromagnetic, Lac Pambrun area: Canada Geological Survey. 5435
Aeromagnetic, Lac Piacouadie area: Canada Geological Survey. 5434
Aeromagnetic, Riviere Epervanche area: Canada Geological Survey. 5432
Mineralogy
Feldspars and pyroxenes, southern, Morin Series: Philpotts, A. R. 5269
Mizzonite, Grenville area, crystal structure: Papike, J. J. 4992
Petrology
Southern, Morin Series, anorthosite-mangerite suite: Philpotts, A. R. 5269
Sedimentary petrology
Quebec Group, fabric of turbidite graywackes: Smoor, Peter Bernard. 5323
Radioactivity
Phosphate
Uranium content: Habashi, Fathi. 5356
Sedimentary rocks
Role in petroleum evolution: Colombo, U. 5145
Radioactivity surveys
California
San Francisco region, airborne: Books, Kenneth G. 5152
Indiana
Eastern, airborne: Bates, Robert G. 5151
Ohio
Central and western, airborne: Bates, Robert G. 5151
Reefs
Pacific Ocean
Pleistocene, absolute ages: Veeh, Hans Herbert. 5218
Reptilia
Captorhinomorpha
Paleozoic, upper, relationships, evolution of middle ear: Fox, Richard C. 5320
Captorhinus aguti
Permian, Texas, Lower, osteology and relationships: Fox, Richard C. 5320
Reptilia
Evolution
Middle ear, path of chorda tympani: Fox, Richard C. 5294
Rothia
Permian, Oklahoma, Chickasha Formation, Blaine-Grady Counties: Olson, Everett C. 5247
Varanodon
Permian, Oklahoma, Chickasha Formation, Blaine-Grady Counties: Olson, Everett C. 5247
Rivers
Bars
Characteristics of sediments: Ore, H. T. 5085
Meanders
Geometry and theory: Leopold, L. B. 5239
Rocky Mountains
Stratigraphy
Cretaceous, cyclic patterns: Dott, R. H., Jr. 5402
Sand
California
Victorville area, quartzite, resources: Bowen, Oliver E., Jr. 5398
Saskatchewan
Absolute age
Precambrian basement rock: Peterman, Z. E. 5055
Areal geology
Black Bear Island Lake area, east half: Morris, A. 5358
Economic geology
Helium, Upper Cambrian occurrences: vanHees, Hendrik. 5347
Uranium, hematite, Lake Cinch deposit: Turek, A. 5052
Geochemistry
Flin Flon area, sulfide deposits, Ni and Co distribution: Faulkner, Edward Leslie. 5420
Maps
Aeromagnetic, Cree Lake area: Canada Geological Survey. 5474
Aeromagnetic, Foster Lake area: Canada Geological Survey. 5470
Aeromagnetic, Geikie River area: Canada Geological Survey. 5473
Aeromagnetic, La Loche area: Canada Geological Survey. 5472
Aeromagnetic, Lloyd Lake area: Canada Geological Survey. 5475
Aeromagnetic, Mudjatik area: Canada Geological Survey. 5471
Aeromagnetic, Reindeer Lake North area: Canada Geological Survey. 5476
Aeromagnetic, Reindeer Lake South area: Canada Geological Survey. 5469
Geologic, Black Bear Island Lake area, east half: Morris, A. 5358
Petrology
Precambriam basement rock: Peterman, Z. E. 5055
Stratigraphy
Regina basin area: Delorme, D. L. 5044

Saskatchewan
Structural geology
Regina basin area: Delorme, D. L. 5044
Sedimentary rocks
Argillaceous rocks
Environmental classification from geochemistry of siderite nodules: Weber, Jon N. 5041
Dolomite
Petrology, Ontario, Gasport Formation, depositional environment: Spurgeon, Ernest S. 5050
Provenance, Tennessee, Flynn Creek structure area: Roddy, David J. 4998
General
Alteration, Permo-Carboniferous section, Jasper National Park: Walasko, J. T. 5348
Fabric analysis, algebraic determination of arithmetic means: Wood, William H. 5024
Geochemistry, analyses, New Hampshire: Billings, Marland P. 5336
Mineral composition, visual estimates, reliability: Dennison, John M. 5027
Graywacke
Fabric, turbidite type: Smoor, Peter Bernard. 5323
Geochemistry, trace-element distribution, relation to provenance: Weber, Jon N. 5048
Mineral composition, cf. Columbia River sediments: Whetten, John T. 5189
Limestone
Geochemistry and technology, textbook: Boynton, Robert S. 5378
Geochemistry, Kansas, Plattsmouth Member of Oread: Galle, O. Karmie. 5243
Lithofacies
Canada, western, Tertiary: Taylor, R. Spence. 5020
Canada, western, Triassic: Barss, D. L. 5019
Sandstone
General description, comparison of quartz and carbonate shallow marine: Moore, C. H., Jr. 5405
Provenance, Alberta, Viking Sandstone: Young, H. R. 5354
Provenance, Ontario, Whirlpool Sandstone, Niagara escarpment: Gietz, Otto. 5051
Shale
Geochemistry, trace-element distribution, relation to provenance: Weber, Jon N. 5048
Sedimentary structures
Bedding
Varve calibration of stratification: Anderson, Roger Y. 5192
Channels
Wyoming, Sweetwater County, spring deposits: Wiegman, Ronald W. 5078
Crossbedding
Interpretation, paleo-flow regime: Jopling, Alan V. 5352
New York, Bluff Point Siltstone, orientation: Sutton, Robert G. 5029
Orientation analysis, algebraic determination of arithmetic means: Wood, William H. 5024
Sedimentary structures
Crossbedding
Pennsylvania, mid-Paleozoic sandstone, Somerset County: Flint, Norman K. 5383
Stream deposits, transverse bars: Ore, H. T. 5085
General
California, Franciscan Formation, Mt. Hamilton quadrangle: Soliman, Soliman M. 5389
Fredericksburg Group, lower, sandstones, Cretaceous, Texas: Moore, C. H., Jr. 5405
New Jersey-Pennsylvania, Lockatong Formation: VanHouten, Franklyn B. 5180
Wyoming, Almond Formation, barrier island sandstones: Jacka, Alonzo D. 5118
Intrusive sill
Alberta, Jasper area, sandstone, mechanism: Bielenstein, H. U. 5042
Sole markings
Oregon, Tyee Formation: Snavely, Parke D., Jr. 5179
Varves
Stratification calibration: Anderson, Roger Y. 5192
Thickness variations, lateral, intrabasin correlation, southwestern U.S.: Anderson, Roger Y. 5305
Sedimentation
Beach transport
Alaska, experimental study: Stanley, Kirk W. 5007
Cyclic
Alluvial plain, mechanisms: Beerbower, James R. 5340
Baselevel-transit cycle: Wheeler, Harry E. 5400
Bedding, second- to fifth-order, varve calibration: Anderson, Roger Y. 5192
Ideal cyclothem, recognition: Pearn, William C. 5175
Patterns, chemical deposits, Arizona: McKee, Edwin D. 5172
Patterns, control by diastrophism: Bissell, H. J. 5341
Symposium: Merriam, Daniel F. 5186
Trace-element periodicity: Angino, Ernest E. 5193
Water-depth effects: McCrone, Alistair W. 5171
World-wide patterns: Dott, R. H., Jr. 5402
Environment
Alluvial plain, cyclic mechanisms: Beerbower, James R. 5340
Cyclothem variants with tectonic change: Krumbein, W. C. 5168
Indicators, fossil orientation and distribution: Toots, Heinrich. 5088
Marine, marginal, recognition and classification: Miller, D. N., Jr. 5087
Mobile belts, cyclic patterns, causes: Dott, R. H., Jr. 5402
Shallow marine, *Ophiomorpha* as indicator: Hoyt, John H. 5086

Sedimentation
Environment
Tidal flat, Gulf of California, Colorado River delta: Thompson, Robert Wayne. 5083
Environments
Barrier island inlets, Georgia: Hoyt, John H. 5084
Canada, western, summary for each period: Webb, J. B. 5023
General, petrographic criteria, Cretaceous, New Mexico: Sabins, Floyd F., Jr. 5226
Rates
Calculation from Th 230/Th 232, accuracy: Antal, Paul S. 5359
Deep-sea sediments, Pacific Ocean, Tertiary: Dymond, Jack R. 5224
Stream transport
Aggrading streams, characteristic deposits: Ore, H. T. 5085
Interpretation, paleo regime parameters: Jopling, Alan V. 5352
Particle shape effects: Briggs, Louis I. 5130
Particle shape effects: Stringham, Glen E. 5131
Tidal cycles
New Jersey: Strahler, Arthur N. 5031
Turbidity currents
Oregon, Tyee Formation, Eocene: Snavely, Parke D., Jr. 5179
Sediments
General
Ecological relations in marine, analysis methods: Lynts, George W. 5026
Mineral composition, visual estimates, reliability: Dennison, John M. 5027
Physical properties and mineral composition, New York, Long Island Sound: McCrone, A. W. 5129
Size analysis, statistical transformations: Dixon, Mark A. 5132
Size analysis, statistical transformations: Sahu, Basanta K. 5133
Geochemistry
Amino acids, thermal stability, Miocene and Recent: Sellers, George August. 5217
Methods
Factor analysis for grain size distributions: Klovan, J. E. 5028
Sand
Fabric, depositional: Jopling, Alan V. 5352
Heavy minerals, New Mexico, statistical methods: Young, Edward J. 5025
Mineral composition, Columbia River, similarity to graywacke: Whetten, John T. 5189
Provenance, Georgia, Mt. Arabia, weathered Lithonia gneiss: Spalvins, K. 5095
Size analysis, Long Point beach, Lake Erie: Watts, Terence Roger. 5047
Seismic exploration
Interpretation
Explosion seismology, submarine, shot location: Hales, A. L. 5108
Seismic exploration
Methods
Compensation of frequency modulated data: McCamy, K. 5109
Ocean bottom roughness, coherent acoustic: Clay, C. S. 5314
Seismic surveys
Georgia
Atlanta area, crustal and mantle velocities: Dorman, LeRoy M. 5098
United States
East coast, anomalous high near Troy, N. C.: Husted, John E. 5097
Seismology
Elastic waves
Noise, general nature, scatter of body waves: Hudson, J. A. 5264
Nuclear explosions, cavity environment: Lewis, H. W. 5303
Plane and spherical, Voigt medium: Clark, George B. 5313
Plane, nomogram for solution of azimuth and horizontal trace velocity: Matheson, Harry. 5107
P waves, velocity, experimental study, southeastern U.S.: Werth, Glenn. 5279
Signal-to-noise ratio, large aperture seismic array: Frosch, R. A. 5262
Stress waves, igneous rocks: Goldsmith, Werner. 5312
S waves, small near earthquakes: DeNoyer, J. M. 5414
Teleseismic signal extraction: Backus, M. M. 5263
Shore features
Barrier islands
General description, Georgia: Hoyt, John H. 5084
Beaches
Sedimentation, gravel transport, Alaska: Stanley, Kirk W. 5007
Sedimentation, tidal cycle of change: Strahler, Arthur N. 5031
Silurian
Canada
Western Plains, Interlake Group, Cordilleran equivalents: Porter, J. W. 5015
Silver
Geochemistry
Biogenic sulfide: MacDiarmid, Roy A. 5357
Soils
Engineering properties
Permeability of repeatedly layered: Kenney, T. C. 5360
Illinois
Douglas County, glacial Lake Douglas basin: Gardiner, M. J. 5005
Wyoming
Rock Springs uplift, southern, Paleocene, Fort Union Formation, basal: Ritzma, Howard R. 5075

South Carolina
Areal geology
Blaney quadrangle: Ridgeway, David C. 5292
Hydrogeology
Coastal areas, salt-water intrusion: Siple, George E. 5036
Maps
Geologic, Blaney quadrangle: Ridgeway, David C. 5292
South Dakota
Paleontology
Mollusca, Cretaceous, Fox Hills Formation, concretion layers: Waage, Karl M. 5182
Stratigraphy
Cretaceous, Fox Hills Formation, fossiliferous concretion layers: Waage, Karl M. 5182
Spectroscopy
Absorption
Silicates, spectra of low iron-content type: White, William B. 5322
Activation analysis
Micas, slow and fast neutron evaluation: Eichholz, G. G. 5099
Technique, advances in U.S.: Guinn, V. P. 5407
Electron probe
Manganese nodules, crystal chemistry, trace elements: Burns, Roger G. 5327
Technique: Smith, J. V. 5001
Infrared
Metal hydroxides, frequency shift related to O-H—O distance: White, William B. 5002
Sulfate minerals, hydrogen bonding-frequency shifts and band splitting: Adler, Hans H. 5066
Statistical methods
Sedimentary petrology
Fabric analysis, algebraic determination of arithmetic means: Wood, William H. 5024
Factor analysis, ecological relations: Lynts, George W. 5026
Factor analysis, grain-size distributions: Klovan, J. E. 5028
Graeco-latin square, variance analysis: Dennison, John M. 5027
Grain-size analysis, transformations: Dixon, Mark A. 5132
Relative deviations, heavy mineral suites: Young, Edward J. 5025
Stratigraphy
Correlation, Fourier analysis for input data: Preston, Floyd W. 5176
Cyclothem analysis: Pearn, William C. 5175
Cyclothem study: Krumbein, W. C. 5168
Structural geology
Trend-surface analysis: Merriam, Daniel F. 5006
Stocks
Montana
Royal, Flint Creek Range: Allen, Jack C., Jr. 5307
Stratigraphy
Correlation
Intrabasin varve: Anderson, Roger Y. 5305
Stratigraphy
Cyclothems
Variations, tectonic-environmental settings: Krumbein, W. C. 5168
Interpretation
Repetitive sequences, psychological factors: Zeller, Edward J. 5185
Methods
Correlation, cyclic deposits, Fourier analysis: Preston, Floyd W. 5176
Cyclothem analysis, statistical: Pearn, William C. 5175
Cyclothem study, statistical and analytical: Krumbein, W. C. 5168
Insoluble residues, use in sequence analysis: Reed, E. C. 5177
Interpretation of periodicity, faunal repetitions: Tasch, Paul. 5399
Stratification studies, phase and facies approaches: Laporte, Leo F. 5169
Stratification studies, varve calibration: Anderson, Roger Y. 5192
Symposium
Canada, western, regional interpretation, atlas: McCrossan, R. G. 5032
Structural geology
Methods
Trend-surface analysis: Merriam, Daniel F. 5006
Submarine geology
Mineral resources
Production problems, technological developments: Wolfe, John A. 5104
Surveys
United States Geological Survey
Basic research program, future needs: Pecora, William T. 5103
Tectonics
Gravity sliding
Colorado, Milsap Creek fault: Gerhard, Lee C. 5419
Island arcs
Evolution, Caribbean region: Furrazola-Bermudez, Gustavo. 5338
North America
Patterns, reflection in stratigraphic record: Sloss, L. L. 5178
Rotation
United States, northwestern, Nevadan orogenic belt, undisturbed alinement: Taubeneck, William H. 5315
Vertical tectonics
Colorado, central, Pennsylvanian: DeVoto, Richard H. 5250
Tektites
Composition
Moldavites, genesis: Philpotts, J. A. 5288
General
Properties, distribution, origin: Garcia Gutierrez, Carlos. 5397
Genesis
Terrestrial: Faul, Henry. 5188

Tennessee
Economic geology
Coal, Ketchen quadrangle: Englund, Kenneth J. 5411
Industrial minerals, clam shells, reagent grade $CaCO_3$: Nelson, D. J. 5190
Maps
Geologic, John Sevier quadrangle: Cattermole, J. Mark. 5142
Geologic, Ketchen quadrangle: Englund, Kenneth J. 5411
Sedimentary petrology
Flynn Creek structure, Chattanooga Shale, dolomite facies: Roddy, David J. 4998
Stratigraphy
Cambrian–Silurian, John Sevier quadrangle, section: Cattermole, J. Mark. 5142
Carboniferous and Quaternary, Ketchen quadrangle, nomenclature: Englund, Kenneth J. 5411
Tertiary
Canada
Western, stratigraphy and geologic history: Taylor, R. Spence. 5020
Caribbean region
Paleontology, Ostracoda, Miocene assemblages: Bold, W. A. van den. 5011
Colorado
Rock Springs uplift, southern, Fort Union Formation, basal fossil soil: Ritzma, Howard R. 5075
Georgia
Adairsville area, Flora, Paleocene–Eocene: Stanley, Edward A. 5090
Gulf Coastal Plain
Northern, Eocene cycles: Fisher, W. L. 5162
Oregon
Coast Range, Tyee Formation, rhythmic bedding: Snavely, Parke D., Jr. 5179
Pacific Coast, Mollusca: Addicott, W. O. 5299
Trinidad
Springvale and Manzanilla Formations, Ostracoda, correlation with Venezuela: Bold, W. A. van den. 5361
Washington
Central, Camas Land sill, and Teanaway dike swarm: Southwick, David L. 5242
Southwestern, Mollusca: Addicott, W. O. 5299
Wyoming
Bridger basin, Wasatch and Green River Formations: Stuart, William J., Jr. 5079
Cumberland Gap area, Wasatch and Green River Formations: Lawrence, John C. 5082
Green River Basin, Wasatch and Green River Formations: Culbertson, William C. 5077
Rock Springs uplift area, Wasatch and Green River Formations, stratigraphy and paleontology: Roehler, Henry W. 5076
Southwestern basins, Mammalia, Eocene faunas, early: Gazin, C. Lewis. 5081
Texas
Absolute age
Houston area, charcoal, Sims Bayou: Slaughter, Bob H. 5382
Areal geology
Black Gap area: Saint John, Bill E. 5274
Economic geology
Limestone and dolomite, Lower Cretaceous: Rodda, Peter U. 5119
Petroleum and natural gas, Gulf Coastal Province, summary: Fisher, W. L. 5291
Electrical surveys
Delaware basin, resistivity sounding, technique and instrumentation: Word, Darrell R. 5012
Geomorphology
Western, lake basins, formation: Reeves, C. C., Jr. 5033
Hydrogeology
Lee County, aquifers and resources: Thompson, Gerald L. 5393
Maps
Geologic, Black Gap area: Saint John, Bill E. 5274
Geologic, Lower Cretaceous limestone and dolomite: Rodda, Peter U. 5119
Paleontology
Mammalia, Pleistocene, Houston area, Sims Bayou: Slaughter, Bob H. 5382
Microfossils, Cretaceous, Albian, Merrill's sponge spicules reexamined: Sarjeant, William A. S. 5417
Protista, Cretaceous, Albian chert nodules, dinoflagellate cysts: Sarjeant, William A. S. 5417
Reptilia, Permian, Lower, *Captorhinus*: Fox, Richard C. 5320
Sedimentary petrology
Central, lower Fredericksburg Group, sandstones: Moore, C. H., Jr. 5405
Stratigraphy
Cretaceous, lower Fredericksburg Group, sandstones, central: Moore, C. H., Jr. 5405
Pennsylvanian–Permian, western, cyclic patterns: VanSiclen, D. C. 5181
Pleistocene, Rita Blanca Lake beds, intrabasin varve correlation: Anderson, Roger Y. 5305
Structural geology
Gulf Coastal Plain, subsurface: Fisher, W. L. 5291
Thermal springs
New Mexico
Energy potential: Summers, W. K. 5297
Utah
Energy potential and water analyses: Heylmun, Edgar B. 5298
Thermodynamic properties
Elastic properties
Nodular minerals, Georgia, ruby in saprolite: Giardini, A. A. 5092
$LiAlGeO_4$
Univariant transition between phenacite–spinel structures: Gaines, A. M. 4987

Thorium
Canada
Elliot Lake, production, reserves: Griffith, J. W. 5158
Isotopes
Th-227, -230, -232, Caribbean Sea sediments: Antal, Paul S. 5359
Production
Resources and availability for nuclear power, 1964–2000: Faulkner, R. L. 5412

Titanium
Geochemistry
Oxide minerals: Lister, Gordon F. 5410

Trace-element analyses
Clam shells
Tennessee: Nelson, D. J. 5190
Cyclic deposits
Need for information: Angino, Ernest E. 5193
Graywacke
Distribution and correlation with age and provenance: Weber, Jon N. 5048
Iron-titanium minerals
North America: Lister, Gordon F. 5410
Manganese nodules
Sea floor, crystal chemistry: Burns, Roger G. 5327
Phosphate
Uranium content: Habashi, Fathi. 5356
Rocks and rock-minerals
New Hampshire, chemical: Billings, Marland P. 5336
Shale
Distribution and correlation with age and provenance: Weber, Jon N. 5048

Tracks and trails
Burrows
Ophiomorpha cf. *Callianassa major*: Hoyt, John H. 5086
Ohio
Ordovician, Cincinnatian Series: Osgood, Richard Grosvenor, Jr. 5214

Triassic
Arizona
Northern, cyclic patterns, chemical deposits: McKee, Edwin D. 5172
Canada
Western, Intervals A, B, and C: Barss, D. L. 5019
Nevada
Spring Mts., repetitive sequence: Larson, Allan R. 5170
New Jersey
Central, Lockatong Formation: VanHouten, Franklyn B. 5180
Pennsylvania
Southeastern, Lockatong Formation: VanHouten, Franklyn B. 5180

Trilobita
Cambrian
Vermont, northwestern, Hungerford Slate, nomenclature: Shaw, Alan B. 5371

Trinidad
Paleontology
Ostracoda, Tertiary, Springvale and Manzanilla Formations, correlation: Bold, W. A. van den. 5361
Stratigraphy
Tertiary, Springvale and Manzanilla Formations, correlation with Venezuela: Bold, W. A. van den. 5361

Unconformities
Canada
Summary, western: Webb, J. B. 5023
Utah
Devonian, Uinta Mts.: Gunn, Donald William. 5207

United States
Economic geology
Uranium, sandstone deposits, mineral and tectonic zones as exploration guide: Nininger, R. D. 5404
Uranium-thorium, production and reserves, 1964–2000: Faulkner, R. L. 5412
Geomorphology
Caves, popular account: Halliday, William R. 5231
Hydrogeology
Gulf Coast, Illinois and Michigan basins, formation waters: Graf, Donald L. 5392
Paleontology
Fossils, problematical, *Ophiomorpha*, Cretaceous, environmental indicator: Hoyt, John H. 5086
Seismic surveys
East coast, crustal structure: Husted, John E. 5097
Stratigraphy
Cretaceous, Pacific Coast, cyclic patterns: Dott, R. H., Jr. 5402
Paleozoic, upper, midcontinent, northern, cyclothems and water depth: McCrone, Alistair W. 5171
Pennsylvanian, Midwest, cyclic patterns: Wanless, Harold R. 5184
Pennsylvanian-Permian, midcontinent, northern, phases and facies: Laporte, Leo F. 5169
Permian, Beattie Limestone, midcontinent, northern, facies: Imbrie, John. 5167
Structural geology
Northwestern, Nevadan orogenic belt, tectonic rotation: Taubeneck, William H. 5315

Uranium
Canada
Elliot Lake, production, reserves: Griffith, J. W. 5158
Colorado
Schwartzwalder mine, production, reserves, occurrence: Downs, George R. 5422
Exploration
Mineral zones in relation to tectonic belts as guide: Nininger, R. D. 5404
Geochemistry
Phosphate rock: Habashi, Fathi. 5356

Uranium
Production
Resources and availability for nuclear power, 1964–2000: Faulkner, R. L. 5412
Saskatchewan
Lake Cinch deposit, occurrence: Turek, A. 5052
United States
Sandstone deposits, mineral zoning, relation to tectonic belts: Nininger, R. D. 5404
Utah
Emery County, Temple Mtn. district, occurrence: Hawley, C. C. 5344

Utah
Areal geology
Emery County, Temple Mtn. district: Hawley, C. C. 5344
Economic geology
Uranium, Temple Mtn. district, Emery County: Hawley, C. C. 5344
Geothermal energy
Resources, review: Heylmun, Edgar B. 5298
Maps
Geologic, Deep Creek Range: Nelson, Robert B. 5155
Geologic, Park City West quadrangle: Crittenden, Max D., Jr. 5110
Geologic, Temple Mtn. district, Emery County: Hawley, C. C. 5344
Paleontology
Conodonts, Devonian, biostratigraphy: Clark, D. L. 5199
Fauna, Cretaceous, Colorado and Montana Groups: Smith, James H. 5332
Porifera, Cambrian, Marjum Formation, House Range, lyssakid: Rigby, Keith J. 5198
Stratigraphy
Beaver County, San Francisco Mts.: East, Edwin H. 5154
Cretaceous, Colorado and Montana Groups, post-Carlile: Smith, James H. 5332
Devonian, time lines from conodont assemblages: Clark, D. L. 5199
Devonian, Uinta Mts., unconformity: Gunn, Donald William. 5207
Juab County, Deep Creek Range: Nelson, Robert B. 5155
Mississippian–Quaternary, Park City West quadrangle, sections: Crittenden, Max D., Jr. 5110
Pennsylvanian–Permian, cyclic patterns, Great Basin: Bissell, H. J. 5341
Wah Wah Mountains, southern part: Miller, Gerald M. 5153
Structural geology
Beaver County, San Francisco Mts.: East, Edwin H. 5154
Juab County, Deep Creek Range: Nelson, Robert B. 5155
Wah Wah Mountains, Blue Mtn. and Wah Wah thrust plates: Miller, Gerald M. 5153

Veins
Colorado
Schwartzwalder mine, uranium-bearing: Downs, George R. 5422

Vermont
Paleontology
Trilobita, Cambrian, Hungerford Slate, northwestern, nomenclature: Shaw, Alan B. 5371

Vertebrata
Cretaceous
Wyoming, faunas, environment, climatic significance: Ostrom, John H. 5330
Evolution
Tetrapods, middle ear, path of chorda tympani: Fox, Richard C. 5294

Volcanoes
West Indies
Martinique, Mont Pelee and related activity: Grunevald, Henri. 5278

Washington
Absolute age
Northwestern, Pleistocene deposits: Esterbrook, D. J. 5381
Glacial geology
Northwestern, C-14 chronology: Esterbrook, D. J. 5381
Magnetic surveys
Puget Sound, 1965 earthquake epicenter: Kaarsberg, Ernest A. 5093
Maps
Geologic, Spokane quadrangle, west half: Griggs, Allan B. 5236
Paleontology
Mollusca, Oligocene to Pliocene, southwestern, n. sp.: Addicott, W. O. 5299
Petrology
Central, Camas Land sill and Teanaway dike swarm, basalt–diabase relations: Southwick, David L. 5242
Stratigraphy
Quaternary, Pleistocene sediments, C-14 correlation, northwestern: Esterbrook, D. J. 5381
Structural geology
Central, Camas Land sill and Teanaway dike swarm, basalt–diabase relations: Southwick, David L. 5242
Grand Coulee area, Columbia River basalts, jointing: Lefebvre, Richard H. 5101

Weathering
West Indies
Martinique, lateritization, soils: Grunevald, Henri. 5278

Well logging
Electrical
Fourier analysis of cyclic sediments: Preston, Floyd W. 5176
General
Applications to underground storage for natural gas, western Kentucky: Brown, J. A. 5222

Wells and drill holes
Alberta
Highwood River area, cores, Mississippian section: Nielsen, Grant L. 5040
Colorado
Moffat County, No. 1 Raeder–Government well, electric log: Ritzma, Howard R. 5074
Oregon
Oil and gas, data summary: Stewart, R. E. 5379
Texas
Lee County, drillers' logs: Thompson, Gerald L. 5393
West Indies
Areal geology
Martinique: Grunevald, Henri. 5278
Maps
Geologic, Martinique: Grunevald, Henri. 5278
Structural geology
Antilles arc: Grunevald, Henri. 5278
Wind work
Texas
High Plains, formation of lake basins: Reeves, C. C., Jr. 5033
Transport
Barchan dunes, California: Norris, Robert M. 5034
Wisconsin
General
History of research and exploration: Black, Robert F. 5282
Geomorphology
Driftless Area, development: Palmquist, Robert Clarence. 5215
Paleontology
Fauna, Cambrian, St. Croix Series, zones: Raasch, Gilbert O. 5342
Sedimentary petrology
Saint Croix Series, histograms: Raasch, Gilbert O. 5342
Stratigraphy
Cambrian, St. Croix Series, cyclic patterns, discontinuities: Raasch, Gilbert O. 5342
Wyoming
Areal geology
Rock Springs uplift, guidebook: Wyoming Geological Association. 5384
Economic geology
Oil shale, Green River Formation: Smith, John Ward. 5080
Petroleum and natural gas, Wamsutter arch: Weimer, Robert J. 5128
Petroleum, Laramie–eastern Hanna basin area, resources: Stone, D. S. 5257
Petroleum, West Moorcroft Dakota field, trap: Mettler, Don E. 5258
Maps
Geologic, Rock Springs uplift: Keith, Bob. 5089
Paleontology
Fauna, Cretaceous, Colorado and Montana Groups: Smith, James H. 5332
Wyoming
Paleontology
Mammalia, Eocene, early, southwestern basins: Gazin, C. Lewis. 5081
Tertiary, Wasatch and Green River Formations, Rock Springs uplift area: Roehler, Henry W. 5076
Vertebrata, Cretaceous, faunas, environments, climatic significance: Ostrom, John H. 5330
Petrology
Southeastern, Laramie Anorthosite: Klugman, M. A. 5248
Sedimentary petrology
Rock Springs uplift, Almond Formation, depositional dynamics: Jacka, Alonzo D. 5118
Sweetwater County, spring deposits, origin: Wiegman, Ronald W. 5078
Stratigraphy
Cretaceous, Almond and Lewis Formations, Wamsutter arch, facies: Weimer, Robert J. 5128
Cretaceous, Almond Formation, Rock Springs uplift: Jacka, Alonzo D. 5118
Cretaceous, Almond Formation, Rock Springs uplift, measured sections: Lewis, J. L. 5331
Cretaceous, Blair and Rock Springs Formations: Keith, Robert E. 5126
Cretaceous, Colorado and Montana Groups, post–Carlile: Smith, James H. 5332
Cretaceous, correlated with Utah and Colorado: Hale, L. A. 5333
Cretaceous, Fox Hills Sandstone, Rock Springs area, facies: Harms, J. C. 5337
Cretaceous, Late, pre–Laramide, Rock Springs uplift area: Roehler, Henry W. 5125
Cretaceous, Rock Springs Formation, and Mesaverde Group, Rock Springs uplift, cycles: Burger, John A. 5127
Tertiary, Fort Union Formation, Rock Springs uplift, southern, basal fossil soil: Ritzma, Howard R. 5075
Tertiary, Wasatch and Green River Formations, Bridger basin, sections: Stuart, William J., Jr. 5079
Tertiary, Wasatch and Green River Formations, Cumberland Gap area: Lawrence, John C. 5082
Tertiary, Wasatch and Green River Formations, Green River Basin: Culbertson, William C. 5077
Tertiary, Wasatch and Green River Formations, Rock Springs uplift area: Roehler, Henry W. 5076
Structural geology
Southeastern, Laramie Anorthosite: Klugman, M. A. 5248
Sweetwater County, Henry's Fork fault, extension: Wiegman, Ronald W. 5078
X-ray diffraction analysis
Data
Acanthite, synthetic: MacDiarmid, Roy A. 5357

X-ray diffraction analysis
Data
Apatite, synthetic, CO_3 substitution effect on cell dimensions: Zapanta-LeGeros, Racquel. 5328
Arsenate analogue of tsumebite: Bideaux, R. A. 5068
Biotite polytypes: Ross, M. 4999
Clino-anthophyllite: Bown, M. G. 5069
Metastrengite and laueite: Moore, Paul B. 5065
Minerals in pelitic schist, sillimanite-potash feldspar isograd, Maine: Evans, Bernard W. 5367
Shattuckite: Mrose, Mary E. 5325
Silicates, atomic thermal parameters: Burnham, Charles W. 5070
Tremolite-ferroactinolite series, synthetic: Hellner, E. 5329
Technique
High-intensity Cr tube and high-intensity vacuum goniometer: Parrish, William. 4993